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A Summary of Current Program, 10/1/67

and Preliminary Report of Progress

for 10/1/66 to 9/30/67

NATURAL RESOURCE ECONOMICS DIVISION

of the

ECONOMIC RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

and related work of the

STATE AGRICULTURAL EXPERIMENT STATIONS

This progress report of USDA and cooperative research is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between October 1, 1966, and September 30, 1967. Current economic research findings are also published in the ERS publications Agricultural Economics Research, a quarterly, and The Farm Index, a monthly. This progress report was compiled in the Natural Resource Economics Division, Economic Research Service; U.S. Department of Agriculture, Washington, D.C. 20250.

UNITED STATES DEPARTMENT OF AGRICULTURE

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INTRODUCTION

The Department's program of natural resource economics research is concerned with economic and institutional aspects of the use, conservation, development, management and control of natural resources; and with the contribution of natural resources to regional and national economic growth.

While our natural resources are abundant, shifts in use, resource development, and institutional modifications are required to meet changing needs for these resources. Underlying the pressures for development and change in use of resources are improved technology of agricultural production and growing urban and industrial demands for land and water. Quality considerations are increasingly important in planning the use and development of natural resources; as are considerations of future needs for natural resources and the problems of meeting these needs. These trends present a challenge to provide useful and reliable research findings to identify alternatives and to aid in natural resource management and planning decisions.

The program of the Natural Resource Economics Division involves national and regional problems of research, planning assistance, and related policy assistance on natural resource problems. The program is headquartered in Washington, D.C., and is carried out through four subject-matter Branches, the Resource Data Systems Group, and five Field Resource Groups concerned chiefly with analyses and planning assistance for regional development of water and related land resources. Field studies generally are conducted in cooperation with State experiment stations or Federal and State resource development agencies. Close working relationships between research and operational programs have long been traditional in this field. This close cooperation in planning and conducting work avoids duplication of efforts and provides opportunities for the direct application of research results.

The program of natural resource economics research is reported under 11 area headings shown in the Table of Contents. More detailed subheadings are given in the discussion of each area of work.

During the year covered by this report, the Division made a number of significant contributions to natural resource policies and programs. Division personnel have responded to requests from the Office of the Secretary, program administrators, the Water Resources Council, Federal Council for Science and Technology, Recreation Advisory Council, Bureau of the Census, and others. Basic data and analyses provided by the Division continue to be utilized in efforts to understand changes and achieve improvements in the development, conservation, and use of natural resources.

Some examples of research accomplishments during the reporting period follow:

Land Use Inventory. Compilation of data for the inventory of major land uses was completed. During the 1959-64 period, total cropland decreased approximately 14 million acres and permanent grassland pasture increased 10 million acres. Total forest land decreased only slightly except in Alaska where reclassification resulted in a 15 million-acre decrease. Indications are that land moved to urban use at a slightly lower rate than during the 1950-59 period.

Economic Impact of Retired People in Resort Areas. A study of retired people in a resort area of Northern Wisconsin, revealed that incomes of retired people living in the area were a stabilizing influence on the local economy, which is recreation-oriented and characterized by part-time and highly seasonal employment. The conclusion was that areas dependent on a recreation industry should consider the possibilities of stabilizing their economies through well-organized programs of promotion for retirement purposes. Planning for retired persons in a community requires consideration of their health and recreation needs.

Irrigation Costs and Practices and Irrigation Water Requirements of Crops. Research on irrigation economics in North and South Dakota was completed for publication. Data on inputs and operating characteristics of various types of irrigation systems were obtained from a survey of irrigators in the two States. Four types of sprinkler systems, as well as gated pipe and surface-type irrigation, were studied. Investment per acre irrigated averaged about \$100 for sprinkler systems, and slightly more for gated pipe and surface systems. Highest returns from irrigation were for corn silage and alfalfa, while the lowest returns were for wheat. Most of the operators surveyed irrigated to increase or stabilize feed supplies, rather than to convert from dry-land farming to irrigated cash-crop farming.

A study of agricultural water use and management in the Southeastern States is estimating the amount of irrigation water required to meet consumptive water use of crops. Results indicate that, for tobacco and alfalfa, as much as a third of the consumptive use would have to be supplied by irrigation if ideal conditions of plant growth are to be maintained.

Public Access to Public Lands. Although public domain is open for many public uses, access is often impaired by lack of identification, lack of roads, or blockading by the owners of private lands. A study of the Piceance Creek area of Colorado showed that trespass fee collections by private landowners from hunters seeking access to public lands were almost double the amounts these same owners were paying for grazing privileges. Private landowners also collected access fees on their own lands. Another study in the Caliente area near Los Angeles, California, involved the first Federal-State Cooperative Land and Wildlife Management Area. The area was dedicated to public recreation but is accessible only by crossing privately-owned lands which is not now being permitted. Several methods for opening access were being considered.

Factors Influencing Reliability of Agricultural Data Obtained by Earth-Orbiting Spacecraft. Considerable potential is thought to exist for collecting agricultural and forestry data by sensor systems carried aboard earth-orbiting spacecraft. The value of such information is dependent on the capability of the sensors to identify and measure specific kinds of land uses over vast areas, and the frequency and speed with which data can be obtained and summarized. Short of total coverage of large earth surface areas at any time, methods for obtaining reliable data for specific crop areas must be devised using sampling techniques. A study of sampling requirements for spacecraft data collection was concerned with the factors influencing accurate measurement of earth areas by sampling.

Economic Potential for Utilizing Wood By-Products in Western RC&D Project Areas. Farmers in four Western Resource Conservation and Development Project Areas are interested in the feasibility of installing plants to bale wood shavings and sack sawdust. Lumber mills in all four project areas have an abundant supply of sawdust and shavings that, for the most part, are not being used. There is a demand for this material by livestock and poultry producers who use it for bedding and by businesses such as packing plants, butcher shops, garages, and auction barns. Factors important to successful sawdust baling or sacking operations include ready supply of raw materials, sufficient volume of operation, and large potential market area demand. Potential for profitable operations were found to exist. However, the relatively low capital requirements for processing firms, \$15,000 to \$20,000, could lead to overproduction unless firms can identify and meet the demand for specific types of sawdust.

Ohio River Basin Comprehensive Survey. The agricultural resources are potentially adequate to satisfy 1980 and later projected needs for food and fiber from the Ohio Basin, as well as its portion of the national demand. Resource development will be increasingly necessary after about the year 2000. However, in the interim, resource development is needed to increase efficiency of the agricultural industry and to help stabilize the income of farm families and dependent communities.

Legal-Economic Aspects of Vertical Coordination Contracts in Agriculture. The law pertinent to contracts used by growers and processors and suppliers has been summarized in terms of available case law and the Uniform Commercial Code. Special attention was paid to bailment, security, warranty, and performance relations of the contract provisions. Over 400 contracts were analyzed in terms of the probable effect of the contract provisions on location of decisions, ownership of the product, and assumption of risk. A classification system was developed and a numerical index was designed to indicate the degree to which entrepreneurial functions were shifted between the farm and off-farm contractor. On a scale of 50, the index ranged from 12 for general livestock to 43 for hybrid seed corn, the latter case indicating nearly complete transfer of the entrepreneurial function away from the farmer.

Generalized Land Inventory Systems. A computerized land inventory system was developed to aid in economic studies for comprehensive river basin planning. The system uses data from the National Inventory of Soil and Water Conservation Needs as its basic input. It summarizes data by land resource areas, river basins, water resource regions, or civil division boundaries and relates these data to cropping patterns and yields. Information obtained from the computerized system is used directly in reports and also as basic economic data for analyzing agricultural land and water resource development potentials.

AREA NO. 1. ECONOMICS OF LAND UTILIZATION

Problem. Population growth, advances in agricultural production technology, changing consumer demands, increased urban concentration, and other factors combine to cause changing demands for the Nation's fixed supply of land. Analyses of current levels and trends in the major uses of land, of the economics of land development and conservation measures, and of land-use shifts provide the basis for informed policies and programs for land-use adjustments and the conservation and development of land resources.

USDA AND COOPERATIVE PROGRAM

Research on the economics of land utilization is divided into two subareas: (A) Inventory and appraisal of land supplies and uses; and (B) land requirements, conservation, and development. This research provides a continuing inventory of major land uses, both farm and nonfarm, regional and national, as well as analyses of trends in type and intensity of land use by States and regions and of shifts in major agricultural uses and acreages absorbed by non-agricultural uses. The research also evaluates alternative methods for acquiring data on uses and potential of land resources and appraises the need for land conservation and development measures, the adequacy of the land-resource base for projected national agricultural output requirements and non-agricultural land needs, and resulting implications for patterns of production.

This research is both basic and applied. The nature of the research makes it necessary to draw upon several scientific disciplines and specialties; including economics, statistics, geography, urban planning, soils, botany, agronomy, forestry, and photogrammetry. Research in this area is financed by directly appropriated funds and by transfer funds from the Soil Conservation Service and the National Aeronautics and Space Administration. During the report year, research was conducted in cooperation with the Hawaii, Arizona, and Minnesota Agricultural Experiment Stations; by contract with the Purdue Research Foundation, Cornell University, and the Systems Technology and Applied Research Corporation of Dallas, Texas; and by reimbursement agreement with the Statistical Reporting Service. Informal cooperation was maintained with additional State and Federal agencies and with other organizations.

Approximately 10.4 Federal scientist man-years were devoted to this area during the reporting period, of which 4.4 man-years were applied to inventory and appraisals of land supplies and uses, and 6.0 man-years were applied to studies of land requirements, conservation and development.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 5.1 scientist man-years was devoted to this area of work.

A. Inventory and Appraisal of Land Supplies and Uses

An inventory of major land uses in 1964 has been completed except for changes expected in final Census data. The inventory is the latest in a generally comparable series developed at five-year intervals. Cropland totaled 444 million acres, or 14 million less than in 1959. Among the components, cropland harvested, crop failure, and cropland used only for pasture declined 26, 4, and 8 million acres respectively. These decreases were partially offset by respective increases of 6 and 18 million acres in cultivated summer fallow and the soil improvement and idle category. Permanent grassland pasture totaled 643 million acres, or approximately 10 million more than in 1959. The net increase reflects the movement of land from crops to permanent grazing use and the clearing and reclassification of forest land. Approximately 759 million acres are classified as forest land. The net total has undergone little change since 1959 except for a downward reclassification of 15 million acres in Alaska. Important changes have occurred in State and regional totals which, to a large degree, offset each other at the national level. Land in urban places, roads, parks, wildlife areas, public installations and facilities, etc., is estimated at 173 million acres. Analysis of the individual estimates indicates some decrease in the rapid rate at which land moved to urban and other special uses in the 1950-1959 period.

Annual data series are maintained on acreage of cropland used for crops. This totaled 332 million acres in 1966, down 4 million from the 336 million acres used in 1965. This approaches the record low of 330 million acres used in 1910, the first year for which such data are available. Land used for crops increased slightly in the Corn Belt, Delta, and Pacific regions, remained unchanged in the Northeast, and decreased in other regions. The largest decrease occurred in the Southern Plains where the acreage used declined 2.2 million acres.

As part of a larger, long-term effort to develop new sources of land use data, the acreage in each of the nonharvested cropland categories (as well as crops planted for harvest) for 1967 were obtained as part of the June Enumerative Survey of the Statistical Reporting Service. This is a stratified random area segment sample yielding a coefficient of variation of about 5 percent at the national level and a usable degree of precision at the regional level. Non-harvested cropland acreage amounts to about 150 million acres and varies from year to year in response to changes in diverted acreage programs. Previously, these data were available only at five-year intervals in the U.S. Census of Agriculture. Annual data on this cropland reservoir are useful in evaluating the impact of diverted acreage programs and planning future programs. Furthermore, prospects are that the 1969 Census of Agriculture will be incomplete for these items, so continuation of this series may depend on development of new data sources. In addition, it is planned to explore the utilization of this sample, which is on a total land area base, to develop estimates of other types of land use not now available; for example, urban use and the uses of non-Federal nonfarmland.

Airphoto comparison analysis is being used to estimate the acreage of farmland shifting to urban and associated use in selected areas. For most of the studies, the nearest available airphotos for the years 1950 and 1960, or as close as possible to these years, are being used to relate population growth to areas of land going into urban and associated use. Airphoto analysis and area measurement have been completed for the North Atlantic Slope Basins, Columbia-North Pacific Basins, California Coastal Basins, and the Minneapolis-St. Paul Metropolitan area. Airphotos have been selected and are on order for the Colorado Basin and airphoto analysis is in process for the Island of Oahu, Hawaii. Tentative findings from the studies on a county basis show the following average annual rates of shift to urban use in terms of acres per 1,000 increase in population: Metropolitan fringe counties, 1,000-9,000 acres; central cities 400-1,900 acres; and, small central cities 100-500 acres.

One staff member is participating in the project to update the National Inventory of Soil and Water Conservation Needs, first carried out in 1958. Field data collection work is practically finished, with more than half of the tabulations already reviewed and evaluated by the county committees. The final tabulations will show 10 different categories of cropland by capability class, as compared with only a cropland total last time. The final report is expected in early 1968.

One staff member served eight months on the Content Planning Task Force set up for the 1969 Census of Agriculture.

Work is underway by Cornell University, under contract, to analyze and compare costs and benefits of remote sensing in agriculture and forestry, U.S. and worldwide, at two levels of technology and for three types of craft: (a) conventional aircraft, (b) high-flying aircraft (above 40,000 feet), and, (c) earth-orbiting satellites.

A study of potential agricultural uses of remote sensing from space platforms was published. Operational agricultural applications of low-altitude remote sensing as well as experiments were reviewed and the fundamental factors governing potential use from space platforms identified. Applications judged to be feasible include inventories of major land uses, reconnaissance soil surveys, bases for mapping, surveys of range conditions, and agronomic surveys. Possibly feasible applications include crop species identification, crop vigor analysis, and crop production estimates.

A study of 33 sample countries to assess the use of conventional airphotos in obtaining agricultural data was completed. Most of the countries were using airphotos in agriculture, with about one-third using them for the first time in the past five years. Twenty-three types of uses were identified. Most foreign countries employed airphotos for only a few of these potential uses while the U.S. utilizes virtually all.

A study of a sample of 34 countries was made to determine the state of agricultural data collection around the world. The countries were sorted into 5 groups according to the accuracy, comprehensiveness, and timeliness of their data on crop areas, yields, and production. The comprehensiveness of their

collection of land use data was also considered. The results of this study will be used to identify and evaluate uses of remote sensors in providing essential information to agriculturists in foreign countries.

A survey was made of non-Federal users of aerial photographs purchased from the Agricultural Stabilization and Conservation Service. ASCS maintains air-photo coverage of the Nation's agricultural land, and prints are available to others at cost. In FY 1966, ASCS received 50,000 orders from non-Federal customers for a total of 471,000 airphotos. A mail survey of a sample of purchasers provided information on types of customers, types and numbers of prints ordered, uses made of prints, estimates of economic benefits, evaluation of specifications of prints, and number of prints acquired from other sources.

A study was completed of the need and potential for sampling in systems for obtaining agricultural data via remote sensing from earth-orbiting satellites. This was done under contract by Systems Technology and Applied Research Corporation, Dallas, Texas. The study was designed to (a) specify the satellite reconnaissance system optimal in terms of present state-of-the-art for obtaining agricultural data, (b) specify agricultural data requirements, (c) identify needs for sampling, and (d) specify practical sampling systems. A polar, sun-synchronous orbit is specified. Instrumentation indicated would be a camera system with 10 to 20-foot ground resolution capable of producing imagery from which crop species can be identified. Orbiting at an altitude of 200 miles and photographing a swath of 1° longitude, such a system would provide coverage of the U.S. in 22 days at any specified hour \pm 2 hours, standard time zones. Allowing for cloud cover, as much as 176 days might be required to cover the U.S. Using measurement of wheat acreage as an example, the study explores alternative sampling approaches and selects point sampling as being the most practical.

B. Land Requirements, Conservation, and Development

Basic data on the present use and productivity of land resources have been developed for approximately 15 soil groups within some 150 physiographic regions. These data are based on acreages of the major crops grown, crop yields, and fertilizer applications provided by soil scientists and work unit conservationists of the Soil Conservation Service. Production cost estimates were also developed for the major crops, utilizing information from recent agricultural production cost studies. These estimates of production cost differentials and regional variations in the availability, quality, and productivity of the land resources will be used in the National-Interregional Analysis of Resources Development Potential (reported under Area No. 8).

Preliminary projections of land use based on an examination of historical trends, analysis of current relationships and evaluation of foreseeable developments were prepared for 17 Water Resource Regions. Initial indications are that the projected demand for food and fiber in 1980 could be met with approximately 20 million fewer acres of cropland than were used in 1965. Even though the demand for agricultural production in subsequent years would require an additional acreage over that estimated for 1980, the total cropland acreage needed probably would not exceed that used during the 1950's (also reported under Area No. 8).

Study of factors affecting agricultural land values in Hawaii continued in cooperation with the Hawaii Agricultural Experiment Station and the Land Study Bureau, University of Hawaii. Data were obtained by field survey on recent sales and leases of cane and pastureland on the Island of Hawaii. These data are being used in a multiple-regression analysis of interrelationships of sale prices, rents, and assessed valuations with independent variables including land quality, value of buildings and improvements, size of unit, proximity to roads and urban centers, and characteristics of sale and lease contracts.

Work was completed on a study, cooperative with the Arizona Agricultural Experiment Station, on effects of a declining water supply on agricultural land use. Using linear programming as the basic tool, an analysis was made of adjustments in land use and cropping patterns as water tables decline and water costs increase in Pinal County, Arizona. The study indicates that, of the main crops grown in the area, acreages of feed grains and alfalfa would decline rapidly as pumping costs increase while cotton would continue to be produced up to program acreage limitations.

Research is underway in cooperation with the Minnesota Agricultural Experiment Station to analyze land-use patterns related to the urbanization process. The study seeks to identify and measure factors associated with the urbanization of rural land as a basis for evaluating alternative methods for achieving desirable changes in land use, including the rates and location of land conversion and the allocation of land being converted to its best use.

Research was initiated in cooperation with the New Jersey Agricultural Experiment Station to evaluate the Farmland Assessment Act of New Jersey. The study seeks to ascertain the specific factors limiting the participation of local assessors and landowners in the program of farmland tax assessment according to agricultural value; and to evaluate the program as a means of preserving agriculture as an open-space land use and encouraging an orderly and efficient transformation of land to urban-industrial uses.

A mail survey of all county agricultural extension agents in the country, carried out with the cooperation of the Federal Extension Service and State extension offices, obtained information on new towns, planned communities, and large residential or industrial developments. Replies were received from more than 90 percent of the counties. More than 500 developments of these types, 950 acres or more in size, were reported. Data were obtained on type of development, location, land area involved, former land use, and, where relevant, anticipated population.

A bibliography on USDA publications useful in the process of planning and development is in process.

A staff member served on the committee which planned the first national symposium on "Soil, Water, and Suburbia: A National Conference on Land and Water Management in Fringe Area Development", sponsored jointly by the Departments of Agriculture and Housing and Urban Development.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Inventory and Appraisal of Land Supplies and Uses

Changes in farm production and efficiency--A summary report. 1967. U.S. Dept. of Agriculture Statis. Bul. 233, tables 4-6, pp. 6, 7.

Supplement II to changes in farm production and efficiency--A summary report. 1967. U.S. Dept. of Agriculture Statis. Bul. 233, 7 pp.

Dill, Henry, W., Jr. 1967. Worldwide use of airphotos in agriculture. U.S. Dept. of Agriculture Handbook 344.

Frey, H. Thomas. 1967. Potential agricultural applications of remote sensing from space platforms. U.S. Dept. of Agriculture Inf. Bul. 328.

Hoffer, Roger. 1967. Interpretation of remote multispectral imagery of agricultural crops. Purdue Agr. Expt. Sta. Bul. 831.

B. Land Requirements, Conservation, and Development

Stults, Harold M. 1967. Predicting farmer response to a falling water table. Proceedings of Committee on the Economics of Water Resources Development, Western Agricultural Economics Research Council, Las Vegas, Nev. December 1966. pp. 127-141.

AREA NO. 2. ECONOMICS OF WATER UTILIZATION AND WATERSHED DEVELOPMENT

Problem. For the Nation as a whole, natural water supplies are adequate to support a three- to fivefold increase in water consumption. Regionally and locally, however, full utilization of water supplies is being approached and serious temporary deficiencies due to drought frequently occur. Flood damage potentials are increasing in spite of extensive flood control programs. Agriculture is the principal consumptive use of water; thus gains in efficiency of agricultural water use, more than in any other use, result in greater supplies for all purposes. Research is needed to provide economic information for identifying and objectively analyzing national and regional problems of agricultural water management and development. Studies reported here are concerned with providing economic facts on water supplies, uses, values, and management needs as they concern farmers, legislators, and administrators, and with analyzing the resulting implications for water management decisions.

USDA AND COOPERATIVE PROGRAM

The current program is divided into four general categories corresponding to the form of support or functions: (1) Basic research, funded from regular ERS appropriations; (2) applied research, supported by funds transferred from such agencies as the Soil Conservation Service; (3) technical assistance to staff engaged in interagency river-basin studies, supported by transfer funds; and (4) professional and service activities.

About 45 percent of the program might be termed basic economic research, of which about one-fifth is extramural with land-grant universities. Applied research accounts for 45 percent of the total program, with some allotments to land-grant universities for facilities and miscellaneous consulting services. The remaining 10 percent of resources are devoted to technical assistance for river-basin surveys (reported in Areas 9 and 10). The total program is divided about equally between field stations and Washington, D.C.

On a subject-matter basis the program in this Area is reported under three subareas or studies, involving elements of basic research, applied research, and related technical service activities. These studies are: (A) Water management and technology; (B) watershed research and planning; and (C) State and regional appraisals. Water-related research increasingly is becoming multidisciplinary. Some of the disciplines involved in addition to economics include meteorology, hydrology, agronomy, soil science, engineering, statistics, and law.

Studies are carried out directly and in cooperation with the agricultural experiment stations, the State water resource institutes authorized in the Water Resources Research Act of 1964, and with personnel or research stations of the Agricultural Research Service. Research was conducted or initiated in direct cooperation with experiment stations and/or water institutes in Colorado, Florida, Hawaii, Indiana, Iowa, Minnesota, Mississippi, North Dakota, Oklahoma, Oregon, Pennsylvania, South Dakota, Texas, and Wisconsin. Indirect cooperation via regional research committees with these and other States is maintained also.

About 13.9 Federal scientist man-years were devoted to this area of work during the year, allocated as follows: water management and technology, 4.2 man-years; watershed research and planning, 4.7 man-years; and State and regional appraisals, 5.0 man-years.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 12.9 scientist man-years was devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Water Management and Technology

A continuing program of studies is concerned with economic aspects of agricultural water management having general application for farms, watersheds, and river basins. Special emphasis is given to interpretation of results of climatologic, agronomic, hydrologic, and engineering studies for their relation to economic decision-making in agriculture.

Progress on the inventory of agricultural water use, a continuing study, consisted of revising and updating information for two reports, "Rural and Urban Uses of Water in the United States" and the water use chapter of the five-year inventory of major land and water uses in the United States.

Plans are nearing completion for a new economic inventory of water use for livestock, rural-domestic, and other nonirrigation purposes. This study will complement the ongoing inventories of irrigation water use.

Research on locational water use and irrigation potentials utilizes climatological and agronomic data on consumptive use to compile seasonal and intra-seasonal irrigation requirements, as an input for preliminary appraisals of irrigation feasibility at given locations. This involves systematic compilation of results of Blaney-Criddle, Thornthwaite, and related consumptive use determinations, and the application of such formulas appropriately modified to provide coverage for other locations of probable interest. Monthly and annual consumptive water-use estimates have been compiled for 29 locations, mostly in the Western, Southeastern, and Middle Atlantic States. A total of 75 estimates of monthly and annual consumptive use and irrigation requirements were prepared for the following crops and locations: alfalfa, 23; corn, 12; pasture, 9; all fruit, 9; cotton, 7; potatoes, 4; sugar beets, 3; sorghum, 3; and all other, 5. A draft report now being revised describes procedures and empirical results for the Appalachian and Southeast regions.

A new study is examining the role of water in regional economic development, considering natural resource, geographic, population density or economic characteristics as criteria for designating regions. Economic growth and development in the New England States are being analyzed on a pilot basis within a framework based on location theory. Specific attention is devoted to the effects of water resources on the pattern of economic development over time. An annotated bibliography of water resource publications in New England States is being prepared as part of the background studies.

Current and newly developing technology of water management applicable to both dryland and irrigated agriculture in the Northern Great Plains Region are evaluated in a project on the economics of irrigation techniques. A survey of selected sprinkler and surface irrigation systems in North and South Dakota was completed during FY 1967, with results tabulated and analyzed. Additional data and information were collected from cooperating research agencies and irrigation equipment manufacturers. The survey showed that most farmers who have sprinkler irrigation are livestock producers rather than cash crop farmers, and have farms larger than the average for the area. Most of them viewed irrigation as a means of minimizing risk by stabilizing or increasing feed supplies, rather than as means of maximizing profits directly through increased crop production. Some farmers--especially those who purchased self-propelled irrigation systems--made large outlays of capital for irrigation facilities, expecting to reduce their labor requirements in proportion. The data do not conclusively show that such farmers succeeded in maximizing profits, though they were able to minimize labor costs. Details on these and other conclusions from the study are in the report, "Irrigation Practices and Costs in North Dakota," to be published at the North Dakota Agricultural Experiment Station.

Extramural research at the North Dakota Agricultural Experiment Station involves analysis of crop response to irrigation water under alternative managerial practices and soil conditions. The crops include small grains, legumes, sugar beets, and potatoes. Managerial practices selected for study were level of fertilization, farming systems, and other practices consistent with irrigation farming. Primary data were collected from irrigation farmers, the North Dakota State University Branch Irrigation Station at Carrington, and county agents. Survey information on type of irrigation system, water supply, and acreage of crops irrigated was supplemented by Census data and Bureau of Reclamation crop reports on Federal irrigation projects. About 80 percent of the systems were of the gravity type, while the remainder were sprinkler systems. Only 2.2 percent of the farmers reporting obtained their water supply from underground water. Alfalfa is produced on a third of the irrigated land. Wheat and sugar beets combined account for another third.

Irrigation technologies and impacts in South Dakota. An extramural study initiated near the end of FY 1967 with the South Dakota Agricultural Experiment Station is expected to (1) determine the economic feasibility of adopting recently improved irrigation technology in selected areas of the State, and (2) estimate the impact of fulfillment of the feasible irrigation potential on the local economy of a selected area in South Dakota. Potentially irrigable areas will be selected according to physical criteria of water supply and suitable soil types. Determination of water supply will include consideration of existing rights and allocations. Labor and capital requirements will be determined for each type of irrigation system suited to the areas selected. Recent improvements in irrigation technology will be emphasized in the selection process. Budgeting and linear programming will be used to determine optimum economic organization of irrigated farms. Input-output analysis of a specific area will be utilized to estimate the impact of full development of irrigation potential on a local economy.

Cooperative research with the Oregon Agricultural Experiment Station on water management in the Pacific Northwest deals with such topics as irrigation water value, water quality management, agricultural drainage, and use of systems analysis in water resource management. Progress on systems analysis included publication of a cooperative bulletin on simulation for river-basin planning and preparation of a related journal article in draft form. On water quality, an input-output analysis of the Yaquina Bay area was completed and reported in a Ph.D. dissertation. Aspects of the study were reported in papers prepared for a regional research committee, the American Agricultural Economics Association, and for the International Conference on Water for Peace. The AAEA paper on "Externalities and Empiricism in Water Resources," concludes that interdisciplinary efforts, reflected in meaningful input-output models, can produce useful measurements of externalities, thus justifying externality concepts as valuable guides in planning. The Water for Peace paper, "Some Possible Roles for Institutions and Economics in Water Resource Management" outlines a method for determining the value of present and alternative resource use patterns, and for indicating management alternatives as well as means of achieving them. A comprehensive publication reporting this and related biological and other engineering studies is being prepared for publication by the Oregon Experiment Station.

Arrangements have been completed for reactivation of Northwest work in the areas of irrigation response, drainage economics, and watershed water balances.

Water and specialized weather information programs. Late in the fiscal year a new cooperative project on the assessment of benefits and costs of specialized agricultural weather service programs was initiated with the Indiana Agricultural Experiment Station, and in informal collaboration with the Weather Bureau, Environmental Science Services Administration, and the Indiana Water Resources Institute. Initial emphasis will be on assessing the merits of alternative techniques for evaluating the benefits and costs of the Weather Bureau's specialized agricultural weather service program in Indiana, one of the Bureau's 12 such programs involving 20 States; and on deriving estimates of the net economic benefit of the program in different areas of the State, considering the interests of the producing, processing, and marketing sectors of the agricultural economy.

Diversified crop production on the Molokai project. This concluded project estimated optimum patterns of diversified crop production on the Molokai Diversion Project in the State of Hawaii. Production costs and yields were estimated by land productivity class for crops suited to the study area. Existing demand and supply functions for these crops were then estimated on the basis of the Honolulu market. These data were used in an iterative linear programming model to derive the optimum allocation of land among alternative crops.

Competitive land use patterns were estimated, with water priced at alternative rates, for both 1965 and 1970. The analysis indicated that diversified producers operating 25-acre units could utilize approximately 450 acres of the project land in 1965 and nearly double that amount by 1970. This increase in acreage would result from projected increases in population and consumer

income, assuming that practically all of the additional production would come from Molokai. Water demand curves associated with the land use patterns indicate that water price had little effect on the quantity of water demanded in the observed price range. The supply of available water is more than sufficient to meet diversified crop requirements throughout the year. In 1965 diversified crops could have utilized 28 percent of the available water. If the project land had been made available in 1965, producers' gross income would have fallen nearly \$800,000 due mainly to lower wholesale prices. Results of this research were published as a bulletin by the Hawaii Agricultural Experiment Station. A journal article describing the iterative programming procedure for estimating optimum land use patterns has been prepared for publication.

Irrigation water values for sugar cane production in Hawaii. Another project in Hawaii concerns the marginal value productivity of irrigation water in several sugar-producing areas. Physical input-output data were collected for a single plantation and plans made to extend the work to an additional plantation. A statistical analysis of the collected data is underway to determine the relationship between water application and sugar production. The resulting functions are to be interpreted in terms of product value, and marginal relationships will be established. Experimental data from one area were used to derive a water balance method for determining the relationship between water and sugar cane yield. A draft manuscript on the economic evaluation of this method was completed.

Value productivity of water in agriculture. Objectives of this study are to estimate for different regions the value productivity of water in agricultural uses and to analyze the effects of technological improvements on the efficiency of water use in agriculture. The analyses will devote special attention to the effects on water use efficiency from improvements in water supply and use technology. Initially, estimates will be made of marginal value products of resources used in irrigated and nonirrigated farming in Minnesota and other North Central States.

A report describing a method for measuring the effects of irrigation on the rate of adopting new technology was completed for Department publication. The report compares technological changes between irrigated and nonirrigated farms in the Texas High Plains, and between irrigated cotton farms in the San Joaquin Valley of California and nonirrigated cotton farms in the Lower Mississippi Delta. The report indicates that efficiency as measured by output per unit of input, is greater on irrigated farms. In each time period irrigated farms maintained a higher efficiency ratio than comparable nonirrigated farms. Technological changes, as measured by shifts in production functions, occurred at a faster rate on irrigated dry area farms than on nonirrigated dry area farms. For example, technology as defined in the study increased an average of 1.84 percent per year faster on irrigated farms than on nonirrigated farms in the High Plains. Different results were obtained by comparing irrigated dry area farms with humid area farms where irrigation is not necessary. Nonirrigated farms in the Mississippi Delta gained in technology at an annual rate 0.96 percent greater than irrigated farms in the San Joaquin Valley. Both comparisons support the hypothesis that a higher level of purchased inputs is employed in irrigated areas. For the High Plains area,

irrigated farms used an average of \$4,927 of intermediate products per year more than did nonirrigated farms. The average irrigated California farms employed \$61,131 more intermediate products per year than nonirrigated farms in the Mississippi Delta.

B. Watershed Research and Planning

Studies involve fundamental and applied investigations of the economic relations of land use, land treatment, and structural improvements to the hydrologic behavior of both small watersheds (roughly under 250,000 acres in area) and large river basins. The relationships are utilized in evaluating the feasibility of resource development projects and the economic consequences of their installation. The studies are carried out in cooperation with the Soil Conservation Service, the Agricultural Research Service and various State agricultural experiment stations, and draw on information from pilot watershed projects of SCS, projects planned under the Watershed Protection and Flood Prevention Act of 1954 (P.L. 83-566 as amended), and experimental research watersheds of ARS and the States. Elements of progress in FY 1967 are as follows:

A new interdisciplinary study of the technology and economics of conservation was established in cooperation with the Iowa Agricultural Experiment Station and the Agricultural Research Service. The general objectives are to evaluate current and developing technology for soil and water conservation, and to determine the economic substitutability of intensive terracing and other land treatment measures for in-channel water control structures. Comparative-cost studies are in process on types of terraces existing in Iowa and other North Central States. Large, parallel, grassed-backslope terraces are being studied first. Crop yield data are being assembled from experimental watersheds and from other primary and secondary sources on relations of terracing costs to field conditions. Concepts guiding the study and progress were reported at a Soil Erosion Problems Symposium held at the 1967 annual meeting of the Soil Conservation Society of America.

Pending the assignment of an ERS researcher to work with ARS scientists on the economics of sedimentation at the U.S. Sedimentation Laboratory at Oxford, Mississippi, arrangements were made for modest extramural research at the University of Mississippi on sedimentation control questions in a broad study of the State's resource development programs and authorities.

A continuing study compiles and summarizes basic data from P.L. 566 watershed work plans (plans for watershed projects authorized under P.L. 83-566--the Watershed Protection and Flood Prevention Act of 1954). Basic statistics compiled from the work plans includes watershed characteristics, recommended works of improvements, costs of improvements recommended, flood damages, benefits, and other related factors. The 1967 inventory report now in process summarizes project information from 817 work plans authorized for operations through June 30, 1967. These projects encompass nearly 48 million acres and the structural measures recommended for them are estimated to cost more than \$1 billion. The measures recommended are estimated to produce more than \$92.5 million annual benefits.

A report on "Distribution of Planned Investments and Estimated Benefits of Small Watershed Projects Authorized Under Public Law 566," was prepared for the National Advisory Commission on Rural Poverty. Planned investments, by purpose, and estimated benefits, by type, for the 722 projects authorized as of June 30, 1966 were presented and discussed briefly for each of the 20 major land resource regions in the conterminous United States, and with respect to the distribution of benefits among rural and nonrural beneficiaries. Also presented were project numbers and land area in projects, as of June 30, 1966, by land resource region plus various related data from the 1959 Census of Agriculture tabulated by land resource region.

Work on pilot watershed evaluations was authorized in the Department of Agriculture Appropriation Act of 1954. The pilot watershed program was the forerunner of the Watershed Protection and Flood Prevention Act, the current basis for most small watershed projects in the U.S. The purpose of pilot watersheds is to demonstrate the feasibility of combining soil conservation measures with upstream detention structures to reduce frequent flooding. Data pertaining to land use, crop yields, production and management practices, and floodwater, sediment and erosion damages are obtained by periodic surveys of farm operators in sample areas. These data are analyzed in conjunction with analysis of physical data compiled by cooperating agencies, (Soil Conservation Service, Forest Service and U.S. Geological Survey), to measure the effectiveness of the project in relation to the estimated results of the watershed improvements. Evaluation studies continued during the past year on four pilot watershed projects: Six-Mile Creek in Arkansas; the Upper Rio Hondo in New Mexico; Mule Creek, Iowa; and East Willow Creek, Minnesota. Evaluation reports covering a 10-year period are being prepared for the Six-Mile Creek and Upper Rio Hondo Watersheds. Biennial data were collected during the past year for the evaluation studies in the East Willow Creek Watershed. A final evaluation report on the Kiowa Creek Watershed in Colorado was issued.

A completed study of socioeconomic factors in rate of watershed development for P.L. 566 and Washita Watershed projects in Oklahoma indicates wide variation in the ability of communities to start and complete upstream watershed projects. The cause of this disparity in rate of development was investigated through a review of the institutions involved and the use of factor, discriminant, and regression techniques. It was hypothesized that success in achieving watershed development through group or community action is some function of the socioeconomic environment. Selected variables were utilized in the discriminant analysis program to categorize and predict the performance of upstream watershed development attempts. Twenty-two variables were then grouped into six factors to identify the underlying structure of the socioeconomic system of the local community involved in the P.L. 566 projects. Interviewees from selected sample watersheds indicated, as did the factor analysis, that Level of Living was the most important factor contributing to success or failure of watershed development. However, a nonlinear and U-shaped regression relationship was indicated, with low and high Level of Living resulting in faster rates of development. The slower projects appeared to be associated with an average Level of Living. Results of the project are detailed in a research bulletin to be published at the Oklahoma Agricultural Experiment Station. Related papers and articles emphasizing certain aspects of the overall study were prepared, including one for the International Conference on Water for Peace.

Research on the correlation of flood damages with alternative land use systems was initiated in cooperation with Oklahoma State University. The main objective is to develop a general computer model for estimating flood damages for alternative land use patterns (1) without a watershed project, and (2) in combination with alternative systems of structures. Subobjectives are to estimate flood damages for specific storms and average annual flood damages and damage reduction benefits on specific subwatershed areas within the flood plain of the watershed for alternative systems of structures and land-use patterns. The Nuyaka Creek Watershed in northeastern Oklahoma has been selected as the primary study area. Large-scale aerial photographs of the flood plain of the Nuyaka Creek Watershed have been obtained. Cross-sections and flood plain boundaries have been located on the photos, and a grid of sample points located at the rate of one point per 5 acres of flood plain.

An interim report on the benefits of upstream flood protection describing the use of point sampling techniques in Oklahoma for estimating flood damage and potential flood prevention benefits was published as ERS 353--"Evaluating Flood Prevention in Upstream Watersheds With an Areal Point Sample." The work is an application of techniques described in Agriculture Handbook 237, on "Sampling, Coding, and Storing Flood Plain Data," published in 1962 as a product of an ERS contract study with the Department of Geography of the University of Chicago. Objectives of the Oklahoma study are to estimate the major economic effects of upstream flood protection projects, by determining reductions in crop and pasture damage resulting from installed structures, benefits from irrigation and drainage on flood plain land stemming from projects, and changes in land-use and intensity as a result of flood protection. A secondary objective is to estimate the relationships between characteristics of specific flood events and the changes in yields and net income from crops and pastures. The interim report, ERS 353, reports results of two years' evaluation of these effects in 11 subwatersheds of the Washita River Basin in Oklahoma, emphasizing methodology and procedures, and describes plans for a larger study encompassing the entire Arkansas-White-Red Water Resource Region.

C. State and Regional Appraisals

Studies and service work in this subarea cover the more aggregative or macro-economic aspects of research and planning assistance. Included are such activities as technical liaison on river basin surveys and research in States or groups of States, and water regions. Some work on secondary impacts and externality questions of water resource development is reported here, as are policy-oriented reviews of development proposals generated by such operating resource agencies as the Soil Conservation Service, the Corps of Engineers (Civil Functions), and the Bureau of Reclamation. Major activities during FY 1967 are summarized as follows:

A cooperative project with the Pennsylvania Agricultural Experiment Station deals with measurement of the impact of external economies and diseconomies involved in watershed and other water resource development projects, and with methods for considering such externalities in planning decisions. A review of the literature on externalities was completed and a theoretical framework for classifying and measuring externalities is being developed. Investigation of externalities imposed by the implementation of a "clean streams" law in

Pennsylvania is in process. Preliminary data on costs of meeting water quality criteria through alternative means have been collected and are being analyzed, and benefits expected to result from improved stream quality are being estimated.

Research on irrigation trends in the North Central Region is carried out as a contributing ERS project to NC-57, a regional research project involving 12 States. Previously derived projections for the North Central and the other regions of the U.S. have been updated to account for 1964 Census estimates of irrigated land. Since projections of future irrigation development must take account of water rights and other legal factors affecting ground and surface water withdrawals, a cooperative study to determine the degree of limitation imposed by Wisconsin's irrigation statutes and permit systems was initiated with the Wisconsin Water Resources Center. Analyses are completed, and a final report in the form of a Ph.D. dissertation is in process.

An extramural project on ground-water management in the High Plains of Texas is underway at Texas Technological College (Lubbock) and the Texas Agricultural Experiment Station. The general objective is to assess the economic impacts of declining ground-water supplies, the impacts being related to low annual recharge rates and high irrigation withdrawals. Work completed in FY 1967 indicated the importance of ground water and irrigation to the producing agricultural sector. Irrigation was found to be responsible for about 60 percent of the \$160 million annually used by farmers in the study area for agricultural inputs employed in cotton and grain sorghum production. In irrigated cotton production, expenditures for fertilizer, seed, and chemicals account for 10 percent of total annual expenditures for all inputs, and are over six times larger than similar expenditures for a comparable acreage of dryland cotton. In comparison with dryland production, irrigated operations in the area require a higher percentage of total crop value to cover input expenditures and have lower residual returns to farmers. Future work will highlight the interdependencies of the agricultural and nonagricultural sectors of the High Plains economy with respect to ground-water resources and management needs.

Research on Southeastern agricultural water management emphasized the feasibility of supplemental irrigation for increasing farm income in the Southeast (including Appalachian areas in the Southeast) estimating optimum extent of irrigation in selected Southeastern areas, and assessing implications for irrigation water use and supply. Estimates of current costs and benefits of irrigating selected field and specialty crops have been developed. Comparative advantages for producing and marketing irrigated crops in selected locations are being determined, considering improved transportation systems. This work is drawing upon results of experiment station research and river basin studies. Cost data have been compiled for field crops and some truck crops, and similar data for other specialty crops and greenhouse production are now being collected. Estimates of yield increases due to irrigation have been assembled for field crops and some vegetables. Work thus far indicates that irrigation is most economic for tobacco production, for some fruit and vegetable crops, and for greenhouse production of vegetable and specialty crops. The overall study is related closely to work on locational estimates of water use (subarea A above), to general investigations of resource development in the Appalachian region (reported in Area 10), and to the Florida study reported next.

A new extramural research project on citrus irrigation in Florida was initiated with the Florida Agricultural Experiment Station. Interest was stimulated in part by a sharp increase of irrigation in the State--from 410,000 acres in 1959 to nearly 1,200,000 acres in 1964. Despite the rapid development of irrigation in the Florida citrus industry, opportunities for profitable grove adjustment resulting from irrigation are not well understood. Irrigation practices vary greatly among groves with respect to the amount of water-related inputs utilized. The general objective of the project will be to estimate investment and operating costs of alternative irrigation levels for Florida citrus groves using efficient irrigation systems designed by horticulturists and agricultural engineers. Investments and costs of operation will be estimated by applying appropriate prices to the physical inputs of selected irrigation systems. Results of the citrus study may be utilized in subsequent research on optimum irrigation practices and systems for other producing situations, and in determining implications of irrigation development for management of Florida's water resources.

Research on the economics of Western streamflow accretions seeks to determine the distribution benefits of water conservation on selected streams in Western States. Records of water rights filed on irrigation streams are being collected from county and State records and from major water distributing organizations. This information permits the identification of marginal water users, presumably affected most by changes in streamflow. Through FY 1967, water rights on many streams in Colorado, eastern Wyoming, and southwestern Montana were tabulated and arrayed according to priority, and the amount of water appropriated determined for each stream. Weekly streamflow records kept by water commissioners have been collected for Colorado showing streamflow over an 11-year period, together with the decrees being serviced each week. Extremes in flow as well as mean and median flows can be identified. In Wyoming, all water right holders have been recorded on maps in order to classify water rights by stream segments.

Work continued on irrigation water delivery simulation studies. This research is evaluating routines for delivery of irrigation water to farms and fields from the standpoint of economic efficiency and selected other decision rules or criteria, analyses are planned for Colorado, California, and other locations. The simulation program, designed in cooperation with the Graduate School of Public Administration of Harvard University, computes production, gross returns, and net income from various systems of irrigation, enabling determination of the most profitable system on a per-farm and aggregate basis. The model evaluates up to 40 farms having as many as 10 crops, for an irrigation season of 14 periods. It simulates the decisions an irrigator or irrigation organization would make in the course of an irrigation season where water availability is limited. The program handles 18 different irrigation distribution rules. Total supply (including streamflow and stored water), as well as seasonal distribution can be varied.

Economic review and preparation of comments was continued for Federal agency reports on water resource development projects. ERS comments, along with those of other Services, are utilized in preparing the Department's views of the proposed project which in turn accompany the report as it is submitted through the

Bureau of the Budget to the Congress. For FY 1967, reviews were completed and comments prepared for 31 Corps of Engineers and 5 Bureau of Reclamation reports. In addition, reviews were made and comments prepared for a number of USDA project plans or reports.

Regional research activities. The Economic Research Service continued to provide the services of a Regional Coordinator for a North Central Regional Research project (NC-57), Economic and Legal Factors in Using, Developing, and Managing Water Resources in Agriculture, in which ERS and 12 States are participating. Progress on the ERS contributing project was reported above.

Staff participated in water and outdoor recreation research workshops sponsored by the Southern Land Economics Research Committee and, later, in the workshop on Water Research Needs sponsored jointly with the University of Florida. Other major regional research activity included participation in activities of the Committee on Economics of Water Resource Development of the Western Agricultural Economics Research Council. Two projects (Western streamflow accretions and economic inventory of agricultural water use--reported above) are contributing to Western Regional Research Project (W-81), Economics of Water Transfer.

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AREA NO. 3. RESOURCE INSTITUTIONS

Problem. Efficiency in use of land and water resources is conditioned by laws, administrative measures, and related institutional arrangements that prescribe the rules and procedures for transfer, use, and management of resources. Rapid rates of population growth and urban expansion, imbalances in agricultural supply and demand, and technological change necessitate improved measures to achieve an orderly and balanced pattern of land and water development and use. Research is needed on the current status and innovations in water law and institutions regarding water use and development; rural zoning and other land-use regulations; and the organization and operation of resource districts and interstate compacts.

USDA AND COOPERATIVE PROGRAM

A continuing program of research is conducted which provides inventories and analyses of resource institutions, including innovations that permit more efficient development and use of natural resources. Much of the research can be characterized as legal-economic utilizing basic information obtained from statutes, constitutional provisions, court decisions, local ordinances, and agency procedures to determine the nature of relevant laws, summarize them, and evaluate their economic impact on the use and development of natural resources.

During the reporting period, researchers were stationed at Washington, D.C.; Berkeley, California; Madison, Wisconsin; and Oxford, Mississippi. Cooperative agreements or contracts were in force with the Legal Institute for Agricultural and Resource Development at the University of Mississippi and Mississippi State University; the Minnesota Agricultural Experiment Station; the Wisconsin Water Resources Center; the Law School, University of North Dakota; and the Colorado Agricultural Experiment Station. Other research was carried out under agreements with individual researchers in Honolulu, Hawaii; Berkeley, California; Denver, Colorado; and Washington, D.C.

Federal personnel cooperate informally with several agricultural experiment stations, law schools and other elements of State Universities, with regional research committees, and with other Federal and State agencies. Frequent contact and consultation, particularly for water law research, exists between researchers and State engineers or other water management officials of State administrative agencies. A number of States have active projects on rural planning and zoning with much of the work being coordinated through extension personnel or other portions of universities. As more local and regional development agencies are formed, the nature and extent of these cooperative relationships are being expanded. Analysis of special districts and related organizations is being expanded by State experiment stations, particularly in relation to water or local economic development. Historically, this work has been done by the governmental research bureaus or political science departments of the universities or State development agencies.

A total of 5.7 Federal scientist man-years was devoted to this area during the reporting period, of which 2.8 man-years were applied to studies of water rights and related laws, 2.0 man-years to land-use regulation, and 0.9 man-years to research districts and organizations.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 3.5 scientist man-years was devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAM

A. Water Rights and Related Laws

Research on legal aspects of water rights in the West was continued. A multiple-volume treatise on the law of water rights in the 19 Western States was completed except for additions to State summaries, and chapters on ground water laws and interstate and international matters. Completed chapters cover such subjects as State water policies, legal classifications of water, the development of water rights doctrines, elements and applicability of the appropriation and riparian doctrines, the protection, loss, adjudication, and administration of water rights, and Federal-State jurisdictional questions.

An updated and revised version of a 1956 publication on irrigation water rights in California was published by the University of California. It summarized the principles upon which irrigation water rights of California farmers are based. These principles chiefly govern the acquisition, determination, administration, holding, utilization, and loss of water rights.

Separate manuscripts on water rights law in Idaho and Wyoming are in preparation. In addition, research was continued on selected legal problems concerning water use in North Dakota.

Research on legal aspects of water rights in the East includes studies of water rights and regulation in Wisconsin, Ohio, Indiana, Mississippi, and Arkansas, and selected aspects of water rights and related laws in the 31 Eastern States lying East of Texas and the Dakotas.

A report is being printed on public rights in water in Wisconsin, Minnesota, Indiana and Ohio. This includes analyses of such subjects as the definitions of navigable or public waters to which public rights attach, the types of uses that the public may make, who may exercise the public rights, public rights vs. private riparian rights, public access problems, and the nature and significance of public trust and easement theories under which the States may act to safeguard public rights.

The manuscript for a book on water-use law and administration in Wisconsin is undergoing final revisions, including revisions necessitated by a recent reorganization of State agencies. This manuscript deals with a wide variety of subjects including analyses of private and public water rights, regulatory and related functions of State agencies and local units of government, and associated Federal, interstate and international matters and constitutional problems.

A manuscript now in preparation reports the findings of a legal-economic analysis of irrigation in Wisconsin. This primarily involves an analysis of economic effects of the operation and administration of the Wisconsin stream-irrigation permit system.

An interdisciplinary study of water resources in the Wisconsin River Basin was initiated. Its special concern is with water quality problems in the basin. Preliminary planning, investigation, and conceptualization is underway and some phases of the study have begun, including a study of local court cases and water-pollution enforcement actions by the Conservation Division of the Wisconsin Department of Natural Resources.

Progress also was made in legal-economic studies of water rights and related laws in Mississippi. Two papers that have drawn upon this research have been published. One was included in Lectures on Law in Relation to Water Resources Use and Development presented at the University of Connecticut. The other was included in the Proceedings of the Water Resources Law Colloquium held at the Pennsylvania State University.

A manuscript for a law review article on the 1956 Mississippi water appropriation statute is undergoing final revisions. It analyzes the meaning and scope of the statute from an examination of its various provisions, its legislative history, its interpretations by the administering agency, its relationship to the common law and other Mississippi statutes, and comparisons with other State statutes. The current statute largely replaces the common-law riparian doctrine regarding surface watercourses with a modified version of the prior appropriation doctrine prevalent in Western States. Some information also is included regarding the handling of water-use permits and claims by the Board of Water Commissioners.

Economic data on the use of water resources in Mississippi were assembled from secondary sources and an investigation of the administration, operation, and effects of the 1956 statute and related laws is continuing.

A number of papers were published or completed on water rights and regulatory legislation throughout the Eastern States. They discuss the development and features of the applicable laws, indicate their complexity and diversity, and point out emerging issues and problems. Topics included were private and public water rights, contractual agreements and other complicating factors, permit systems and other regulation of water use, development, or pollution by State agencies and local governments or districts, control over the use of developed water sources, and provisions regarding minimum streamflows or lake levels.

One of the papers was published by the Water Resources Study Committee of the University of Maryland and another was prepared for the International Conference on Water for Peace. Other papers were published in Proceedings of the Water-Rights Law Conference sponsored by the New England Council of Water Center Directors and the Water Resources Law Colloquium at the Pennsylvania State University. A paper on State water rights and regulation as related to water and associated land resource planning and development is to be included in the report of the Coordinating Committee for the Ohio River Basin Comprehensive Survey. It is based on a speech given at a meeting of the Committee in Cincinnati.

A manuscript in preparation analyzes Eastern court decisions regarding ground water. Other studies in which progress was made include a study of the development of the riparian doctrine and analyses of selected legal aspects of water

pollution. An investigation of selected common law and statutory problems and local court cases involving pollution is underway.

A preliminary report was completed on legal aspects of water quality standards and their enforcement under the Federal water pollution control legislation as related to agricultural and rural resources.

A preliminary manuscript for a supplemental national bibliography on water-law publications is being revised and expanded, and a draft manuscript for a bibliography of publications dealing with Federal-State conflicts in jurisdiction over water resources has been compiled.

Research was initiated regarding legal aspects of weather modification and the history of the Federal interest in weather modification. Research also was begun on the historical development of the water resources planning policy expressed in the Water Resources Planning Act of 1965.

Related work of researchers included such activities, in response to requests, as the reviewing and formulation of suggestions concerning proposed water legislation for North Carolina and New York, providing advice and suggested sources of information for the formulation and conduct of a study of water laws in Georgia, and working with two North Central regional committees concerned with economic and legal factors in using and allocating water resources. This included serving on a joint committee to plan and arrange a seminar on water resources research to be held in 1968.

B. Land-Use Regulations

Adequate land-use plans combined with a workable system of land-use controls are realized necessities for more and more American communities. Local leaders and planners, working to make them reality, want and need to know how and what to do to create plans and regulations suitable to local needs. Research is underway to provide them with this kind of information.

Specifically, the objective of the research being done in this field is to appraise the status of and analyze developments in rural zoning enabling statutes and ordinances and to analyze what is being done under the rural zoning ordinances.

Legal techniques are used to examine, analyze, and classify all State rural zoning enabling statutes which empower counties, townships or other governmental units to adopt ordinances and regulations. The subsequent rural zoning ordinances and regulations enacted by local governmental units are similarly collected, analyzed, and classified. Emphasis is on rural planning and zoning as it relates to agriculture and natural resource uses. Special attention is directed at significant zoning innovations and related land-use control techniques.

Several papers were prepared for presentation at seminars with national, State, and local leaders in the natural resources field. One such presentation entitled, Zoning Fertile Soils for Farming in New York State, was prepared for a meeting of the New York State Commission on Preservation of Agricultural Land.

This group is made up of State Officials and leading citizens, appointed by the Governor, to study the problem of rapid disappearance of prime farmlands. The report stressed the types of information needed to compile an adequate land-use plan and the alternative land-use control measures now in use in other States.

A related presentation was made at the Workshop on Adopting Public Institutions to a Changing Society sponsored by the Southern Extension Region Public Affairs Committee. This paper stressed the techniques for using renewable natural resources data in the community planning process and the implementation of comprehensive plans through zoning and other techniques.

A publication explaining procedures and data requirements for developing and fulfilling Comprehensive Plans for Improving Rural Counties was printed and distributed. Suggestions for Planning and Zoning in Appalachia also was printed.

A popular publication, The Why and How of Rural Zoning, was slightly revised and reprinted. Over 21,000 copies of this publication have been distributed to date.

Work was continued on a publication Planning and Zoning for Better Use of Rural Resources sponsored by the Land Use Planning and Zoning Committee of the Soil Conservation Society of America. Leadership for planning and editing the publication is given by a senior researcher, who also has written about half of the chapters. Other chapters are being prepared by Society members and invited contributors.

The study of the relationship of flood plain, recreation and other conservation zoning to the Watershed Protection and Flood Prevention Act, P.L. 566, continued, with an expansion in the collection and refinement of basic data from legal-economic literature, court cases, rural planning and zoning enabling statutes for each State, and some 400 county and other rural zoning ordinances. The second phase, expected to begin soon, contemplates on-site studies to (a) determine the extent to which zoning in the watersheds is used in conjunction with the P.L. 566 projects, and (b) evaluate pertinent operating features of zoning laws and Federal-State-local programs as tools in the management and development of rural flood plains.

Planning processes, organizations, and institutions were the subject of a paper presented at a workshop sponsored by the Resource Use and Development Subcommittee of a North Central regional research committee. The workshop was a working session to define researchable areas in resource development. Within that limitation, the paper discussed the planning process, the planning organization, planning and institutions, and other issues. The papers may be distributed as working documents.

C. Resource Districts and Organizations

The organizational structure of resource development is complex and is becoming more so as social and economic development programs and new organizations to administer them are created. The research underway is oriented toward defining

the structure of the organizations themselves and the relationships between them and established governmental units. Legal-economic research techniques are used for analyzing and expressing relationships.

Because of the current resource development trends, much of the research initiated recently is oriented toward water organizations, although some of it also has more general application.

One study, initiated during the year, is developing a basic inventory of Federal, State and local organizations and institutions concerned with water resource development as a basis for further analysis of legal-economic relationships of resource organizations. The review of Federal water organizations was completed and the comparable enumeration of State and local organizations in all 50 States is nearing completion. A report on the inventory phases of the study is being prepared.

A narrower, more intensive study of the Legal and Economic Aspects of Water Management in Hawaii was completed by a contractor. This study traced the legal and historical development of water rights and institutions in Hawaii. The principal organizations in Hawaii are governmental in nature with few special districts or private organizations involved in water development. The report concluded that no new changes in Hawaiian water law or institutions are needed at this time.

A major institutional study of water resource organizations was initiated under contract with Colorado State University. This project is a systems analysis approach to the study of institutional functioning and change at the local and State level related to water resource use and development in the Arkansas Valley of Colorado. The study will investigate the legal, social, political, and economic forces for change and the adjustments existing organizations will have to make to accommodate such change.

A paper was prepared for the International Water for Peace Conference sponsored by the State Department in May 1967. The paper was oriented toward the topic of water institutions and specialized in the legal and institutional characteristics of special districts and mutual companies used for water development. The legal and historical development in the United States was used for illustrative purposes, but some emphasis was placed on their potential for use in developing countries.

One of the general studies of organizations was a legal analysis of special district enabling legislation and cases on special districts in Colorado with the objective of classifying the significant legal and corporate forms among several different classes of special districts. Colorado has 30 enabling statutes under which districts can be formed. These can be divided into three main groups based upon their purposes, types of taxing and other public powers, tax liability, the degree of public or private interest involved in their functions, and their independent corporate existence and status. These three types of districts are: (1) Quasi-municipal corporations, which are created to serve the inhabitants of the district, and which therefore have the power to levy ad valorem taxes, and are exempt from paying taxes to the State, counties, and other units of local government; (2) public or quasi-public corporations, which

are created by landowners to construct, maintain, or operate an improvement which will enhance the value of their lands, and which therefore have only the power to levy special benefit assessment taxes, and are not exempt, without special statutory provision, from State, county, and other local governmental taxes; and (3) special taxing districts, which are created by municipal governing bodies, and are operated under their supervision and whose legal existence is indistinguishable from the parent city, town, or county which created them.

A study of resource development organizations and their structure initiated in cooperation with the Minnesota Experiment Station last year is progressing, and the first phase of the study is essentially complete. Special districts were inventoried and their activity summarized. An inventory of expenditures for natural resources by various governmental units during the years 1960-1966 is underway. Work under a second phase during the year concentrated on the legal characteristics of special natural resource districts in Minnesota; and their organizational structures, powers, financial limitations, and main functions as specified by Minnesota State Statutes. A draft publication covering these two phases is being prepared.

A. Water Rights and Water Legislation

Champion, William M. 1967. Altering a system of water rights--look before you leap. In Lectures on Law in Relation to Water Resources Use and Development. Inst. of Water Resources, Report 2. Univ. of Conn.

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Ellis, Harold H. 1967. Developing trends in water law in the eastern States. In Proceedings, Water Resources Law Colloquium, sponsored by Institute for Research on Land and Water Resources. Pa. State Univ. Inf. Rpt. 51, pp. 24-45.

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Ellis, Harold H. 1966. Water-rights laws in New England: Summary and observations. In Proceedings, Water Rights Law Conference, Boston, sponsored by New England Council of Water Center Directors.

Ellis, Harold H. 1966. Water rights and legislation in the eastern United States. In Water Resources Management in Maryland, Appendix C, Water Resources Study Comm., Univ. of Md.

Hutchins, Wells A. 1967. Irrigation water rights in California. Calif. Agr. Expt. Sta. Ext. Serv. Cir. 452, revised. 54 pp.

Hutchins, Wells A. 1967. Background and modern developments in State water-rights law. In Waters and Water Rights, Ch. 2, Vol. I, Robert E. Clark, ed., Allen Smith Co., Indianapolis, Ind.

Waite, G. Graham. 1967. A four State comparative analysis of public rights in water. Univ. of Wis. Ext. Serv., College of Law. (In process).

B. Land-Use Regulations

Solberg, Erling D. 1967. Suggestions for planning and zoning in Appalachia. Econ. Res. Serv., ERS 330, 52 pp.

Solberg, Erling D. 1967. The why and how of rural zoning. U.S. Dept. Agr., Agr. Inf. Bul. 196, revised. 58 pp.

Solberg, Erling D. 1967. Experience with rural zoning. Talk before conference on The Future of County Zoning in Oregon, Univ. of Oregon, Eugene, Oreg. September 14-15. 20 pp.

C. Resource Districts and Organizations

Campbell, Bruce G., and Lawlor, P. Timothy. 1967. Digest of Federal natural resource legislation: 1950-66. Econ. Res. Serv., ERS 355. 62 pp.

AREA NO. 4 LAND TENURE

Problem. The security, efficiency, and general well-being of rural people and others can be improved through better tenure arrangements. Research of the firm is needed to help develop tenure devices that permit efficient and flexible organization of farms and other rural enterprises. To guide policies and programs, research is needed to determine the effects of economic change among resource owners and resource users and to determine the impact of various public measures on access to resources.

USDA AND COOPERATIVE PROGRAM

The continuing program of land tenure research is carried out in three principal subareas: (A) Basic information on tenure; (B) analysis of tenure arrangements; and (C) structure of resource ownership and control. Current emphasis is on the effect of tenure systems on the ownership and control of resources and data systems for storing tenure information.

Research was carried out in Washington, D.C. and at field locations at Michigan State University, the Agricultural Law Center of the University of Iowa, and Colorado State University. Work under cooperative arrangements was done at the Law School, University of Cincinnati; the Agricultural Experiment Station, Ohio State University; Law School, University of Iowa; and the Experiment Station, Virginia Polytechnic Institute. Staff members also participated actively in regional research committees in the Great Plains, North Central, and Southern regions, and in the Interregional Land Tenure Research Committee.

A total of 2.8 Federal scientist man-years was devoted to this area of research during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 8.6 scientist man-years was devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Basic Information on Tenure

Work was continued on landownership and land use in a low-income area in Appalachia. Two low-income counties in Southwest Virginia, one with access to industrial employment and one without, were compared for differential effects on landholding and on the intensity of land use. Preliminary information suggests that an area with access to outside employment shifts to extensive land uses while an area without access intensifies land use.

The cooperative research on a Comprehensive Unified Land Data System (CULDATA) with the University of Cincinnati was concluded with a tristate conference on alternative methods of implementing an electronic cadastral system. Many jurisdictions are already installing independently developed data systems, and lack of compatibility may result in large public investments incapable of generating needed information. Continued effort is needed to improve filing, recording, surveying and information processing. On the basis of study thus

far, there appears to be no insurmountable survey or engineering obstacles to widespread use of automated systems; but legal obstacles are formidable. Present data-generating units of county, town, and city governments need coordination, but economies of the improved, coordinated system have not been adequately estimated. The Department of Transportation is continuing the study of feasibility of the CULDATA system under contract with the University of Cincinnati.

A project was initiated with Ohio State University in June 1967 on the development of a rural-urban interface for an electronic land data system such as CULDATA. The objective is to design a manual or simplified system useful for low turnover rates for land and one especially suited to agricultural or sparsely settled areas.

A one-page set of questions on the agricultural tenure situation was developed and included in the ERS General Enumerative and Pesticides Survey which was conducted in early 1967. Preliminary tables were constructed for use in machine tabulation, but results have not been received.

B. Analysis of Tenure Arrangements

The project on public access to public lands under agreement with the Bureau of Land Management was completed. Several hundred parcels of BLM land have been, or are now, involved in access problems. Under the impetus of the Classification and Multiple Use Act and other executive and legislative pressure, the BLM and other public agencies are seeking to develop new uses of public land, as well as reconcile conflicting interests already in existence. Two BLM planning units--the Piceance in Colorado and the Caliente in California--were studied. In the Piceance unit, landowners blockaded deer hunters from access to public lands and admitted them on payment of a trespass fee. In 1965, access, and in effect the use, of these public lands cost hunters an estimated \$21,000--nearly double the grazing fees paid to BLM on the area. Nonresident hunters in the Piceance area produce \$118,000 annually in the area (\$90,000 of expenditure, plus \$28,000 of secondary income). The Caliente area is a public recreational area cooperatively administered by the Federal and California governments, which is isolated from public access by surrounding privately-owned lands. Despite protracted negotiation, the government agencies had neither secured landowners' cooperation nor condemned for public access. Other research on public lands included exploratory investigations on site values (with Forest Service), and intensive agriculture (with Public Land Law Review Commission).

Another study inaugurated in late June was a contract with the University of Iowa Law School to evaluate the extent and effect of joint tenancy holdings of personal property.

C. Structure of Resource Ownership and Control

Research on the locus of entrepreneurship continued with preparation of an initial statement for review by the Interregional Land Economics Research Committee. The statement develops a series of hypotheses based on two ideals, the independent farmer and the open market. Conclusions are not yet available.

The staff assisted in international agrarian reform activities. Under a request from the Department of Labor, the United States response to a questionnaire on tenants and sharecroppers was prepared and negotiations for a draft recommendation at the International Labor Conference were carried out. One senior staff person was a member of the United States delegation to the International Labor Conference in Geneva, Switzerland, where the topic of rural tenancy was under discussion.

Regional research committee participation by the staff included work on an evaluation of the regional research in resource economics, and the development of new research orientation of the Southern Land Economics Research Committee.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Basic Information on Tenure

Boxley, Robert F., Jr. and Ben-David, Moshe. 1967. Parity of net worth: Comment. Jour. Farm Econ. Vol. 49, No. 3. August 1967. pp. 745-747.

Wunderlich, Gene. 1967. Cost of communicating by transportation. Jour. Econ. Issues. Vol. I, No. 3 (In process).

AREA NO. 5. OUTDOOR RECREATION AND NATURAL BEAUTY

Problem. Demands for outdoor recreation in rural areas are increasing. These demands stem from increasing urban populations with increasing incomes, expanding leisure time and improving mobility. These trends provide the potential for increased incomes and job opportunities for rural residents. Increasing appreciation of aesthetics is strengthening the demand for efforts to maintain and improve the beauty of the rural countryside. Recognition is growing that the private sector has a significant role in expanding recreation facilities and improving natural beauty through rural resource development and management. Research information is needed to aid individual, local, and regional planning for recreation development, and analysis is needed of the economic benefits from development of rural area recreation and natural beauty resources.

USDA AND COOPERATIVE PROGRAM

Research relates present and future use of resources to provision of outdoor recreation experiences required for a growing population. Studies include determination of physical resource characteristics, locational factors and qualities of management and services required for successful recreation enterprises and public resource developments; inventories of natural resources available for recreation development; surveys of recreation activities and user preferences; demand analyses for various kinds of recreational experiences; analyses of recreation enterprise costs and returns; assessments of the impact of recreation developments on local economies; analyses of the interrelationships between public and private recreation developments; and aesthetic considerations in natural resources development planning and use.

Formal research cooperation was continued with the Wisconsin Agricultural Experiment Station and the University of Michigan, and was established with the Missouri, Nevada, and New Hampshire Experiment Stations during the year. Informal cooperation is maintained with many Government agencies, regional research groups, State experiment stations, and other organizations.

Approximately 3.8 Federal scientist man-years were devoted to the program during the last fiscal year.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 19.1 scientist man-years is devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

The study of rural recreation enterprises in Wisconsin, begun two years ago in cooperation with the Agricultural Experiment Station, is progressing on schedule. This research is proceeding from analyses of the firm, including individual types of recreation facilities and services, to the broader economic relationships of recreation areas and the total recreation industry in relation to the demand for recreation activities. Manuscripts for several recreation enterprises are completed or nearing completion, including farm vacation, skiing, and retirement homes in resort communities.

The latter study, for example, determined that sufficient numbers of retired persons are living in resort areas of northern Wisconsin to provide a noticeable stabilizing influence on the local economy, which is recreation-oriented and characterized by part-time and highly seasonal employment. The conclusion was that areas dependent on a recreation industry should consider the possibilities of stabilizing their economies through well-planned programs of retirement living promotion.

The vacation farms studied indicated profitable operation for small well-managed enterprises supplemental to the major farming activity. Returns to family labor and management per day worked tended to decline for farms on which the vacation enterprise represented the major source of income.

A survey of 47 skiing enterprises was conducted. About 40 percent were organized as nonprofit associations or clubs. The remainder were commercially oriented. An investment of approximately \$200,000 is required to provide the minimum commercial facilities demanded under Wisconsin conditions.

The study of factors affecting decision-making for recreation developments in the Marquette-Alger area of the Upper Peninsula of Michigan, was continued in cooperation with the School of Natural Resources, University of Michigan. Some shift of emphasis has occurred to accommodate the growing impact of the Pictured Rocks Recreation Area development on the area economy.

Preliminary results of a survey of rural recreation enterprises in Appalachia indicate that most enterprises are part-time operations. Many of the operators are retired and appear to be operating their enterprises as a source of activity rather than for income.

Research on improved procedures and methodology for evaluation of recreation as a multiple-purpose in water resource development programs was initiated in cooperation with the University of Missouri. Similar studies were initiated at the Nevada and New Hampshire Experiment Stations to develop methodology for evaluating problems unique to their areas.

A short survey was made of development and management problems associated with increased demands for recreation use of suburban forests, and research needs were outlined for future consideration. Exploratory work was continued on the economic aspects of natural beauty. Two papers developing economic concepts of natural beauty for resource planning and management were prepared for annual meetings of the Massachusetts Association of Conservation Districts and the Soil Conservation Society of America.

In addition to research, considerable staff assistance was provided for related activities. A staff member serves on the USDA Working Party on Outdoor Recreation. This committee functions on the USDA policy staff and supports participation of the Department on the President's Council on Recreation and Natural Beauty. A major project of the Working Party was a report of a subcommittee chaired by ERS specifying needs for research in support of Departmental programs for recreation and natural beauty. As chairman of the Outdoor Recreation Subcommittee of the Southern Land Economics Research Committee, a staff member organized and conducted a seminar on Outdoor Recreation Research in the South.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

- Davis, Jeanne M., and Johnson, Hugh A. 1966. Operating vacation farms. In Guidelines to Planning, Developing and Managing Rural Recreational Enterprises. VPI Ext. Serv., Bul. 301. pp. 354-362.
- Gillespie, Glenn. 1967. Water oriented outdoor recreation. In Workshop on Water Research Needs. Univ. of Florida, IFAS Bul. No. 3 (In process)
- Huff, Judith M., Johnson, H.A., Madden, J.P., and Taylor, G.C. 1966. Rural outdoor recreation facilities. In State and Local Public Facility Needs and Financing. Joint Econ. Com., 89th Cong., 2d Sess., Joint Com. Print. pp. 555-569.
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- Johnson, Hugh A., and Taylor, Gary C. 1967. Economic benefits from recreation development. (Summary of full paper). In Proceedings, 21st Annual Convention, The National Association of Soil and Water Conservation Districts, Cincinnati, Ohio. pp. 83-84.
- Stipe, Sterling H., and Pasour, E.C. 1967. Economic opportunities for selected recreational enterprises in the North Carolina Piedmont. N. Car. Agr. Expt. Sta., Econ. Inf. Rpt. No. 1.
- Street, D.R. 1967. Recreation economics--fee fishing in Pennsylvania. AE & RS 62. Dept. Agr. Econ., Pa. State Univ. (In cooperation with ERS). 10 pp. Mimeo.

Taylor, G. C., and Russell, J.R. 1967. Outdoor recreation development in the South: problem areas for economic research. In Outdoor Recreation Research in the South. Hugh A. Johnson, ed., Southern Land Economics Research Committee Pub. No. 5, April 1967. pp. 13-18. Published by Dept. of Agr. Econ., VPI, Blacksburg, Va.

Tharp, Max M. 1966. Qualifications of the successful owner-operator of a commercial outdoor recreation enterprise. In Guidelines to Planning, Developing and Managing Rural Recreation Enterprises. VPI Ext. Serv. Bul. 301. pp. 137-143.

Tharp, Max M. 1966. Development of market potentials for income producing recreation. In Guidelines to Planning, Developing and Managing Rural Recreation Enterprises. VPI Ext. Serv. Bul. 301, pp. 149-159.

AREA NO. 6. RESOURCE INCOME DISTRIBUTION

Problem. The economic well-being of rural people and others over time is determined by levels and distribution of resource income. Allocation of income to factors of production is affected by performance of resource markets, tenure institutions, other institutions and public programs. Changes in income, to land and other fixed resources has major distributional effects due to capital gains or losses. Public programs having benefits incident to land create capital gains to initial landowners, but these gains eventually become increased capital requirements and production costs to new landowners. If this occurs, an added consequence of such programs could be lower income to labor used in farming. Research is needed on the distribution of resource income, particularly on how it is affected by the interrelationships of public programs, tenure institutions, other institutions, and technological advance, and how people in local nonfarm sectors and rural communities are affected by public programs concerned with agriculture or natural resource development. In addition, information is needed on the interarea effects of farm and natural resource programs.

USDA AND COOPERATIVE PROGRAM

The program of research emphasizes studies of effects of natural resource-oriented institutions, policies and programs upon levels and distribution of resource income among people in different occupations and locations. Analyses are made of past, current, and prospective levels of land resource income and relationship of these levels to other factor shares. Emphasis is placed upon determining the role of land and other institutions in distributing gains and losses arising from public programs. The indirect effects of farm and natural resource programs are evaluated through estimation of structural relations among sectors of local economies and through additional study of resource fixities within these sectors. Much of the research is carried out cooperatively with the Agricultural Experiment Stations, including, during the reporting period, the Minnesota, Colorado, and Louisiana Experiment Stations.

Approximately 2.9 Federal scientist man-years were devoted to this area during the reporting period. This was a reduction of 2.3 man-years from the previous year, resulting from transfer of professional staff to other research areas and the detail, of the senior researcher, to the staff of the National Advisory Commission on Rural Poverty. Staff time was allocated as follows: Distribution of resource income, 0.2 man-years; and incidence of benefits and costs of public programs, 2.7 man-years.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Distribution of Resource Income

Research initiated during FY 1965 to analyze trends in land income was completed during the year. A manuscript reporting the results of this research has been prepared for publication at the Iowa Agricultural Experiment Station.

Work initiated during the preceding year on analysis of variations in income of rural farm people in Minnesota and parts of adjacent States continued, and the statistical analysis is nearing completion. This study will provide tests of a number of hypotheses regarding what explains variations in income among farm families such as variations in location in relation to urban places, education, age of household heads, and soil quality. This research is expected to be completed during the next year.

B. Incidence of Benefits and Costs of Public Programs

The main activities during the year on studies of the incidence of benefits and costs of public programs were devoted to various phases of the analysis of the Great Plains Conservation Program. Summaries of data on Federal shares of costs of this program by States, counties, and practices were nearly completed. A sample of about 200 contracts (one-third of the total) in 14 counties of the Central Great Plains were partially summarized during the year. Information from these records will emphasize the practices adopted and inputs required by participants and the Federal government for installing these practices. Also, these records will provide the basis for classifying and sampling participants to be interviewed.

Plans were developed during the year for estimating physical effects of Great Plains Conservation Program practices. The Soil Conservation Service will assist in making these estimates. Plans also were completed during the year to sample and interview about 150 participants and 150 nonparticipants in a 14-county area of Northwestern Kansas and Eastern Colorado. The schedules for this interviewing were completed for field use and sampling plans were developed. Under a research contract with a member of the faculty of Colorado State University, a statistical analysis of interrelations of public programs and other variables in their influence upon land values in the Great Plains was nearly completed. Work under cooperative agreements with other members of the faculty of Colorado State University included assembly of data for use in determining how the various public programs interact in influencing farm production, and land and other resource income, and for use in a regional input-output analysis of the 14-county area. Data also were assembled for estimating the time distribution of wheat yields for incorporation in the simulation scheme to be used in projecting the agricultural economy of the 14 counties.

Studies of legal and administrative aspects of the Great Plains Conservation Program were continued during the year. All phases of the research are scheduled for completion during FY 1968.

Work continued on development of data for analysis of income distributional effects of alternative public programs in Southwestern States.

During the year, the senior member of this research area participated in related regional research committee work, including a subcommittee on income distribution of the Southern Land Economics Research Committee. He also devoted most of his time to duties as Staff Economist, National Advisory Commission on Rural Poverty. In this position, he provided leadership to the staff and Commission on income distributional effects of natural resource, farm and related programs.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

A. Distribution of Resource Income

Hoover, Dale, Back, W.B., and Martin, Joe. 1967. Workshop on income distribution: Review, appraisal and research implications. Dept. of Econ., N. Car. State Univ., Raleigh, N. Car. 17 pp.

AREA NO. 7. QUALITY OF NATURAL RESOURCES

Problem. Population growth, industrialization, economic expansion, and unprecedented changes in science and technology are among the forces that affect the quality of natural resources. Public interest and concern about the quality of resources is reflected in recent legislation such as the Clean Waters Restoration Act of 1966 and the Air Quality Act of 1967. Growing concern about possible adverse effects of agricultural operations is also evident. In some instances, efficiency of agricultural production and changes in resource quality are closely linked. The relationship becomes more significant as methods of production and processing become more complex. Research is needed to develop economic information and to evaluate economic problems directly related to quality of natural resources in rural areas. Areas of major current concern are pesticide, fertilizer, and other chemical residues; animal wastes; and air and water pollution. This area of research seeks to provide economic information pertaining to wastes and effects on resource quality, and analytical techniques to determine optimum compromises between production efficiency and adverse monetary and aesthetic effects of changes in resource quality.

USDA AND COOPERATIVE PROGRAM

Research is conducted on the nature and sources of rural area pollutants, trends in adverse impacts and changes in technology which may improve or intensify adverse effects on the quality of land, water and air resources. Case studies of adverse effects are carried out, and alternative pollution control measures are evaluated. Conceptual and quantitative studies are conducted to improve techniques for appraisal of adverse effects and to develop planning procedures for the consideration of resource quality in comprehensive resource planning. Cooperation was continued with the Iowa Experiment Station. One Federal scientist man-year was devoted to this area during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

A total of 1.0 scientist man-year was devoted to this area of research.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

Research continued on the effects of pesticide residues on soil and water resources. The study consisted of a review and analysis of research and monitoring data published by the Agricultural Research Service and available from other sources. There appears to be no evidence of a general and progressive buildup of chlorinated hydrocarbon pesticides in either soil or water.

Staff activities included participation in numerous work groups and task forces, including the Water Quality, and Sedimentation Work Groups of "Project Potomac," a Water Quality Task Force and Water Quality Policy Committee of the Water Resources Council, and others. Economic aspects of the agricultural pollution, animal wastes, sedimentation, cost sharing, cost allocation, and water quality standards were considered in these assignments.

Cooperative research continued with Iowa State University on the analysis of water pollution from pesticides and other agricultural wastes. Present techniques for evaluating economic impacts of pollution will be approved and agricultural pollution control alternatives are being evaluated in a watershed case study.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

Biniek, Joseph P., and Taylor, Gary C. 1967. Economics of water quality. In Workshop on Water Research Needs, Univ. of Fla. IFAS Bul. No. 3. (In process).

AREA NO. 8. NATIONAL-INTERREGIONAL ANALYSIS OF RESOURCE DEVELOPMENT POTENTIAL

Problem. Development of comprehensive plans for all major river basins was recommended by the Senate Select Committee on National Water Resources in its report of January 1961. This recommendation is being carried out through a cooperative interdepartmental program of surveys conducted under the auspices of the Federal Water Resources Council. The product of these surveys is to be a generalized plan for the development of the water and related land resources of each of the water resource regions. Formulation of these plans requires an adequate framework of economic data, projections, and systems of analysis. Moreover, these data, projections, and analytical systems should be consistent among regions and with national expectations in order to avoid grossly under- or overstating the potential of any single region. To obtain such consistency requires that the generation of the above elements be coordinated. It is the aim of this area of research to produce economic data and projections for the water resource regions that are internally consistent, and to develop systems of analysis appropriate to both inter- and intraregional analysis of the data and projections.

This type of economic research is needed to identify potentials for developing major water resource regions, and to relate their relative economic efficiencies to emerging national and regional requirements and objectives. Continuous re-appraisals are required to evaluate changes in the potential supply of and demand for natural resources in relation to development potentials of the various regions.

USDA AND COOPERATIVE PROGRAM

Current activities are concerned with the following areas: (1) Development of a bank of data related to natural resources, and of systems appropriate to the processing and retrieval of these data; (2) development of a set of projections of economic activity and resource use in the agricultural and related sectors for the Nation, and for water resource regions; and (3) development of econometric methods of analysis and projections for use in studies of the water and related land resources in each water resource region or river basin.

A total of 4.4 Federal scientist man-years was devoted to this area during the reporting period. (This total includes 1.5 scientist man-years reported under Area 1.)

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area of work.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Development of a Data System Related to Natural Resources

Economic analysis of alternative resource development proposals requires data of many types and from many sources. This area is primarily concerned with

data related to agricultural water management problems and related land resources. These data need to be in a form that will make them readily available for use in economic analysis. Types of data included are physical measures of land and water resources, qualitative measures of these resources and their potential, and information to measure the impacts of natural resource use and development on regional and local economies. Much of the data are not directly available. Therefore, "proxy" elements must be sought that can be measured, and, which in turn tend to measure the basic element itself. The first step in developing the system was taken in the preceding year. At that time, approximately 300 items, on a county basis, from the 1949, 1954, and 1959 Censuses of Agriculture were converted to automatic records. Verification of the accuracy of the data conversion was completed during the reporting period. The computer system to permit rapid, inexpensive, and flexible retrieval of this information was further developed by improving the format of the computer output to permit more rapid interpretation of the data. The number of items included in the information system for the 1959 Census of Agriculture was increased to approximately 450. In addition, preliminary data of the 1964 Census of Agriculture were introduced into the system. The 150 new items included for 1959 are compatible with data from the 1964 Preliminary Census data. Data from the 1958 Conservation Needs Inventory also were included in the system. This series includes acres by major land use and soil capability class and subclass for all counties in the United States. Summaries were prepared for land resource areas, regions, and selected subregions in support of river basin planning efforts.

B. National-Interregional Analyses and Projections of Economic Activity and Resource Use in the Agricultural and Related Sectors

This activity involves examination of major factors expected to shape future changes in the geographic distribution of agricultural output and employment. They include: (1) Agricultural production and marketing technology, their differential effects between regions and subsectors of the agricultural economy and their impact on the structure of related economic sectors; (2) regional differences in availability, quality, and productivity of the natural resource base and related potentials for increased output in terms of production cost differentials; (3) transport cost factors relative to future centers of consumption, as indicated by population projections; (4) prospective depletion of natural resources available for agricultural use resulting from depletion of ground water, deterioration of soil resources, and encroachment by nonagricultural developments; and (5) tradition, institutions, public programs and other factors that influence the location of agricultural activity through their effect on agricultural output and land use.

This activity is carried out in cooperation with the Office of Business Economics, Department of Commerce, which prepares projections for the U.S. and water resource regions of population, employment, and other measures of economic activity in the nonagricultural sector of the economy.

ERS responsibility includes projecting agricultural employment and income, land use patterns, and production of the major agricultural commodities as well as the impacts of the projected levels of agricultural output on sectors structurally related to agriculture. (These latter projections are closely

coordinated with the work of OBE.) Preliminary projections of this type were completed during the year for the United States and its 17 Water Resource Regions. This report, containing projections for the years 1980, 2000, and 2020, was submitted to the Federal Water Resources Council. These preliminary projections are based largely on analysis of the historical relationship between the national economy and that of the individual regions as modified by projected losses or gains in the resource base of each region. This set of national-regional projections is being used in framework studies (reported in Area 9) of the Ohio, Upper Mississippi, Missouri and Columbia-North Pacific water resource regions and will be used in similar studies in the four Pacific-Southwest Region studies.

C. Integrated Econometric Systems of Economic Analysis and Projections for Use in Framework Studies

This area of activity supports Areas 9 and 10, as well as B reported above. These areas require the simultaneous handling of many types of data collected from numerous sources. The general pattern of analysis for regional studies is often similar to that for individual basins, thus offering opportunities for obtaining economies in operation and consistent research results from a generalized, integrated system of processing and analysis. This system was conceived during the year as a Water Resource Region Agricultural Analytical and Projections System (WRRAPS). This system consists of three broad phases--Input, Mathematical Projections, and Economic Transformation.

Progress during the year was primarily in developing a generalized mathematical projections system. This system accepts various types of input, organizes it in a form acceptable by a mathematical programming system and writes reports of the results in one integrated operation. Numerous options permit simulation of resource development, agricultural technology impacts and institutional constraints on the agricultural production sector.

AREA NO. 9. REGIONAL APPRAISALS FOR NATURAL RESOURCE DEVELOPMENT

Problem. A critical need exists for comprehensive long-range regional planning for development and conservation of water and related land resources. Early resolution of problems associated with the planning of small areas is required as regional plans are developed. Proposed projects can fail to achieve optimal development because of less than full consideration of all needs and development potentials. A restricted or fragmented approach to planning also interferes with full consideration of alternative sources and costs of products and services obtainable from water development projects. Reflecting these problems which have long been recognized by professional workers, the Senate Select Committee on National Water Resources in its report of January 1961 recommended the development of comprehensive plans for all major river basins of the Nation. This recommendation is being implemented by current coordinated planning efforts of a number of Federal agencies working under the general guidance of the Federal Water Resources Council. Completion of the coordinated program of comprehensive surveys for major water resource regions of the Nation is scheduled for 1972.

Long-term regional strategies for water resource development are expected from this program. The results are expected to embrace the following:

1. Identification of future patterns of water and related land use considered most desirable and appropriate.
2. A general plan and schedule of water resource development, by subbasin, required to achieve the desired pattern of water and related land use.
3. Analysis of the economic implications of alternative plans and schedules of development.
4. Development of analytical systems for modifying the plan as new information or unanticipated events, may require.

In summary, the framework investigations should make two major contributions: (1) Generate a matrix of physical and economic information from which plans for effective and balanced systems of water resource development may be formulated; and (2) in the aggregate, provide information needed to shape national water policy.

USDA AND COOPERATIVE PROGRAM

Studies undertaken by the Natural Resource Economics Division, ERS, are coordinated with survey efforts of the Soil Conservation Service, the Forest Service, and other Federal Departments, and carried out under the general guidance of the Water Resources Council. Work carried out by the Economic Research Service involves the following elements:

1. Analyses and projections of economic activity in the agricultural and related sectors of the economy.

2. Projections of the demand, supply and use of land resources for agricultural and other rural purposes.
3. Analysis of agricultural and rural water problems as they relate to the volume, composition and value of production, employment, and levels of income in affected communities.
4. Assessment of agricultural and rural needs for water and related land resource development.
5. Appraisal of the economic effects and consequences of development alternatives on the agricultural and related sectors of the economy, and dependent rural communities.

Although basic research is undertaken, emphasis is on applied research. The work is carried out in Washington, D.C., and in several field locations with regional headquarters in Little Rock, Arkansas; Fort Collins, Colorado; East Lansing, Michigan; Upper Darby, Pennsylvania; and Logan, Utah.

Survey data and analyses reported for this area of work are prepared for use by agencies cooperating in coordinated water resources planning. Reference documents and research reports listed as publications for the area are available from regional offices.

A total of 9.6 Federal scientists man-years was devoted to this area of work during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area of work.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

The study of the North Atlantic Region is in its second year. Projections of farm population, employment, and income were made for the target years of 1980, 2000, and 2020, and coordinated with the Office of Business Economics' non-agricultural projections. An inventory of present land use was completed. An exploration of methodology applicable to future land use in this highly urbanized and industrialized region is underway. A summary report of the agricultural economy of the North Atlantic Region was initiated.

The Ohio River Basin Study was completed during the year. Basic findings were reported in previous years. Formulation of a plan of development is in process and formal review of study reports prior to printing and distribution is underway. Both of these activities will be completed in the coming year.

Projections for the Upper Mississippi River Basin Study were completed for cropping patterns in each of 16 basin planning subareas, both with and without additional water resource developments. The implication of these projections and a discussion of present and projected agricultural economic developments are summarized in appendix reports. The study indicates that the basin can

continue to produce its share, in increasing volume, of the Nation's food, feed and fiber needs without additional water resource developments until about the year 2000, although drainage and flood protection would reduce the marginal costs of production. Corn production costs for example, could be reduced by an estimated 6 percent in 1980, and 12 percent in 2000. After the year 2000, the level of projected demands would call for water resource development, or an accelerated rate of technological advance to achieve greater agricultural output.

An analysis of the water resource plan formulation in process will consider the effects of alternative water plans on the agricultural and associated sectors. This analysis will be included as an appendix to the Upper Mississippi report.

In cooperation with the Great Plains Agricultural Council and State agricultural experiment stations in the Missouri River Basin, projections were made of changes in the productive capacity of the land and of changes in livestock feeding efficiency. These projections along with production cost data and projected basin production requirements are inputs for an analytical system tested during the year, to be used in an economic appraisal of agricultural water resource development in the basin. Initial results of the analysis indicates that the basin can produce the projected 1980 share of national food and fiber demands without further water resources development. Preliminary reports prepared during the year in connection with the overall basin study include eight subbasin reports on land use, six subbasin reports on the agricultural economy, and an overall report on agricultural production projections. These preliminary reports will be revised as results from the analytical system become available.

The study outline and plan of work for the Columbia-North Pacific Region were completed. Secondary data were compiled and analyzed for the planning subregions, States and regions as a basis for projecting output and employment in the agricultural and food processing sectors of the economy, and for use in a report on the present agricultural and food processing economy of the region. This report will be prepared under the guidance of the USDA Field Advisory Committee for distribution and use by all study participants. Preliminary regional projections show a population increase for the region from 5.4 million in 1960 to 7.5 million in 1980, and 14.4 million in 2020. Total employment would change from about 2.0 million to 5.5 million over the 60-year period. However, farmworkers would decrease from 242,000 to 91,000 in the same period.

The Colorado Economic Base Study utilizes the input-output interindustry technique. Input-output models have been developed for six subbasins covering the total Colorado River Basin for 1960, 1980, and 2010 under three constraint situations: (1) "No constraints" except that agricultural projections recognized the compacts and court decisions; (2) water quality constraints; and (3) water quantity constraints.

Primary attention was given to water quantity and quality constraints. The initial projections were constrained by quantity in the Gila Subbasin (Phoenix-Tucson area), and by quality in Gila Subbasin and Lower Main Stem Subbasin (Yuma-Las Vegas area).

On an assumption of completion of the Central Arizona Project or equivalent water supply, ground water depletions and increased water costs would reduce irrigated acreages and result in cropping pattern adjustments.

Detriments to the economy of the Lower Main Stem Subbasin have been estimated for 1980 and 2010 under assumed quality conditions. Agricultural detriments are based largely on lower yields and total gross output. Detriments in other sectors of the economy are purchases of additional water, treatment costs, or increased household expenses. Similar kinds of estimates are being made for the Gila Subbasin. Present appraisals suggest that quality problems will not be serious under present proposals for development in the other four subbasins.

Three studies were initiated during the year; California Region, Lower Colorado Region, and Upper Colorado Region. Interagency organization, plans of study, work groups, and budget estimates for the three regions were completed. Economic subregions were delineated and arrangements completed for data compilation and regional and subregional projections at Washington, D.C.

Input-output models will be utilized in resource appraisals for the three regions. A workshop of economists and others was held at Las Vegas, Nevada, in May 1967 to review in detail input-output studies available for this purpose and their potential application to this program.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

Cotner, Melvin L. 1966. Water--its agricultural use as a factor in regional development. In Proceedings, Public Policies Relating to Water. Sponsored by North Central Public Affairs Committee. Univ. of Missouri Ext. Div. MP 2. pp. 125-141.

Natural Resource Economics Division, ERS. 1967. Ohio River Basin comprehensive survey: appendix F, agriculture. Cooperative Report by SCS, ERS, and FS, U.S. Dept. of Agriculture.

Stewart, Clyde E. 1967. Discussion of: Report on Southern Nevada Project. In Proceedings, Committee on Economics of Water Development. Western Agricultural Economics Research Council, Las Vegas, Nev. December 1966. pp. 149-151.

AREA NO. 10. RIVER SYSTEMS PLANNING

Problem. Management and development of water and related land resources are sources of concern in vast areas of the country. Among the conditions of concern are: (1) Critical water shortages, causing distress in both rural and urban areas; (2) deterioration of water quality; (3) increased demand for water resulting from increased population and growth of water-using industries; (4) depletion of ground-water supplies; and (5) development of sites suitable for water shortage.

Unprecedented interest and activity in comprehensive river systems planning have resulted. These planning efforts promise several benefits compared with the traditional, single-purpose approach such as: (1) Effective programs involving more complete consideration of benefits and adverse effects; (2) better utilization and more efficient distribution of scarce water supplies among competing uses and areas, thus contributing to economic growth; (3) more profitable use of capital available for development; and (4) improved design and scheduling of projects.

USDA AND COOPERATIVE PROGRAM

Current investigations concern development of improved methods for river systems planning; participation in plan formulation for river basins and sub-basins, including investigations to identify and evaluate economic needs for development in rural areas, and analyses of benefits and costs of development alternatives; and economic review of Federal agency reports on proposed water resource developments. Most of the investigations are applied economic research which contributes to interagency-interdepartment comprehensive studies.

Research at field locations is cooperative with the Soil Conservation Service, the Forest Service, and, in some instances, with State water resource agencies, the Corps of Engineers, the Public Health Service, and other public agencies. Survey activities of the Federal agencies are coordinated by the Water Resources Council.

The work is carried out in Washington, D.C. and in several field locations. Regional headquarters are maintained at Little Rock, Arkansas; Fort Collins, Colorado; East Lansing, Michigan; Upper Darby, Pennsylvania; and Logan, Utah.

Although similar in subject matter to work described in Area No. 9, survey activities reported in this area are more detailed than those reported in Area 9 and cover areas smaller than the major water resource regions for which "framework plans" are developed. Plans for subbasin areas are of such character that specific projects needed within the next 10 to 15 years are identified. Subbasin plans are expected to be consistent with the framework plans of water resource regions. Objectives and criteria are of such nature as to require improved and more complete analytical systems. Investigational efforts are focused, therefore, on the types of analyses that contribute to optimal choices in the planning process regarding the location, combination of purposes, scale, and scheduling of water resource developments.

Survey data and analyses for this area of work are prepared for use mainly by agencies cooperating in coordinated water resources planning. Reference documents and reports listed as publications for the area are available from regional offices.

A total of 24.9 Federal scientist man-years was devoted to this area of work during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area of work.

PROGRESS---USDA AND COOPERATIVE PROGRAMS

Reports dealing with present and projected water requirements and the agricultural economy of the Susquehanna River Basin (Pennsylvania and Maryland) were prepared for use by participating agencies. Assistance was given the Soil Conservation Service in preparation of the Irrigation, Land Treatment and Management, and Flood Damage Reports. Methodology and field investigations for Impact Studies of proposed Crops of Engineers' and P.L. 566 reservoirs were initiated.

A report for the major tributary of the Kanawha River Basin (West Virginia) was completed in cooperation with the Soil Conservation Service and the Forest Service. Cropland harvested is expected to continue to decline throughout the projection periods which will facilitate revegetation and reforestation required to reduce erosion in the rolling topography of the basin.

A draft report was prepared on "Agricultural Trends and Projections by Reference Subdivisions for the Connecticut River Basin" (Connecticut, Massachusetts, New Hampshire, and Vermont). This report provides the basis for assessment of needs and background information for the Plan Formulation process to follow. In general, a decline in land use and employment for agricultural purposes is evident. Higher yields and shifts to more intensive production, however, would result in a relatively constant output from agriculture. An analysis of the ability of the private sector to supply water-based recreation was begun.

A study of the Western New York River Basins (New York) was initiated. Major efforts were on preparation of work outlines and inventorying available resources and water problems. This study is closely coordinated with the New York State Water Resources Commission and the Regional Water Resources Planning and Development Boards. Evaluation of the possibilities of irrigation development is underway.

A study of the James River Basin (Virginia) was begun. Major emphasis was placed on the preparation of work outlines and an inventory of available resources and water problems. Preparation of the economic base data necessary for the assessment of water development needs was started.

Studies in support of the Appalachian Water Resource Survey include projections of land use and production, investigation of costs and benefits of drainage and irrigation, appraisal of potential for water-oriented recreation in upstream areas, and evaluation of impacts of water resource development on the structure and performance of local and regional economics.

Preliminary projections of land use indicate a continuing decline in cropland and pasture and an increase in forest and nonfarmland. Estimates of drainage benefits and costs were developed from data used previously in studies of the Ohio and Southeast River Basin Studies and from data collected from the Soil Conservation Service. Benefits from drainage ranged from \$2 to \$8 per acre annually in the various subregions of Appalachia after payment of all farm and off-farm costs. Studies of irrigation costs and benefits are in process. Cost estimates are being developed on the basis of experiment station data and updated materials from the Southeast River Basin Studies. Benefits are based on analysis of weather data and yields of the major crops in the region over a 30-year period. A simplified index of soil moisture conditions is related to crop yields through regression analysis. Preliminary results indicate that irrigation is not sufficiently profitable to attract farmers' capital in the production of major crops in Appalachia. Investigation of irrigation on specialty crops is continuing. Results of the investigations are being incorporated into the USDA Report on the Appalachian Water Survey. A separate report on the potential for water-based recreation in upstream areas is in process.

Economic studies demonstrating the need for and benefits of water resource development for the Red River Basin (Louisiana, Arkansas, and Texas) are nearly complete. Review manuscript drafts on irrigation, drainage, upstream watershed management, and land use have been completed. Fish, wildlife, and recreation aspects of the comprehensive plan are nearly complete. An outline for a USDA report has been adopted. Projections of population and economic activity indicate that without development, deficits in agricultural production needs for the basin could be expected in 1980. With proposed developments in place, only a small deficit in livestock feeds would remain. Findings are summarized in a report prepared for interagency use.

Input data were developed for a least-cost analysis of agricultural production in the White River Basin (Missouri and Arkansas). These data will be used in a linear programming model to indicate shifts in land use with and without project development for future time periods. A preliminary run for 1980 indicates, that with expected yield increases in major crops, farmers can meet food and fiber demands with the present land base. The agricultural portion of the economic base study was completed. This report indicates that net income per farm should increase over 30 percent between 1964 and 1980. Large increases in the production of soybeans and poultry are expected.

Major activities on the studies of the Big Black, Pearl and Pascagoula Rivers (Mississippi) included economic analyses on the Big Black and Pascagoula Rivers. In the Pascagoula River, developments planned for early action will make it possible to meet agricultural production, water quality control and water supply needs, but not all of the water-dependent and water-enhanced

recreational needs can be met in 1980. Reports were prepared for the Pascagoula and Big Black Rivers and working data were compiled for formulation of a development plan for the Pearl River.

Data from the economic base study for the St. Johns River Basin (Florida) were summarized. Future demands for agricultural products were translated into needs for water and related land resources within the area. Anticipated yield increases due to technological advances were studied in estimating future resource needs. A preliminary analysis of development needs is currently underway.

The economic base data for the South Grand-Osage River Basin (Missouri) are being analyzed. Projections of population employment, income, and agricultural production were completed. Preliminary projections were made of the effects of technology on the future productive capacity of the area.

Secondary data were collected and are being tabulated for the Coastal and Independent Streams (Mississippi and Louisiana). An economic base study is being prepared. Findings, along with other agency reports, will be used in basin plan formulation.

The general economic base for the Hatchie and Chickasaw Rivers (Mississippi and Tennessee) was developed. Employment was analyzed by 32 industrial categories and an aggregate base-service ratio was developed. Population projections were developed in cooperation with the Corps of Engineers. Other projections included employment, per-capita income, and land use. These indicators of economic activity and growth will be utilized in evaluating the land and water resource development needs. Data are also being collected to analyze the effects of alternative development proposals.

A plan of work and a work outline were completed and adopted for the Santee River Basin (North and South Carolina). A network analysis of the planning process is being developed.

The St. Joseph River Basin (Indiana and Michigan) study was completed and a final report was transmitted to the Corps of Engineers. Total available cropland for agricultural use is expected to decrease through its conversion to nonfarm uses, including idle land held for speculative purposes. Under the assumed conditions of the study, however, sufficient cropland exists to provide for the production requirements of 1980 and for some time beyond. After 1980, it is expected that some land best suited for pasture and forest will move into crop production. Consequently, agricultural resource development, through irrigation, drainage and flood protection, may prove a more efficient means of production.

Preliminary sub-watershed investigations of the Grand River Basin (Michigan) have identified 13 economically justified upstream watershed areas with a potential for development in the next 10 to 15 years. These developments will alleviate flooding and inadequate drainage on about 63,000 acres, and were estimated to provide average annual benefits of \$1.6 million. Included are structural measures for flood prevention, recreation and drainage. Twenty-six additional upstream watershed areas could be developed, but benefits

necessary for project justification accrue primarily from changed land use. Ground and surface water supplies are in excess of agricultural needs, but distribution with respect to time and place of need will remain a problem in localized areas. Alternative means of meeting development needs will be assessed in the course of formulating a plan for the basin.

Analysis of the potential of water resources development for the Big Muddy River Basin (Illinois) indicates that flood protection would benefit a maximum 200,000 acres while drainage would benefit a maximum 250,000 acres after the year 2000. When demands for agricultural production press on the supply potential, irrigation would be required to provide the needed increase in agricultural output. These estimates do not reflect the impact of total project development costs. If project costs were added to the flood protection and drainage analysis an undetermined acreage of marginal flooded and wetland would be eliminated for consideration of benefited acres up to the year 2000. After 2000, this acreage of marginal flood and wetland likely would be called into production, along with the acreage suitable for irrigation. Bringing in these lands would be in response to a need to relieve supply limitations, and would result in a substantial increase in production costs. Draft reports summarizing the studies were prepared during the year.

Projections of economic activity in the Wabash River Basin (Indiana and Illinois) were completed for the years 1980, 2000, and 2020 using revised costs and yield data for the six economic subareas of the Basin. In each of the projection years, the available land resource would be adequate to meet the Basin demands for food and fiber without further water and related land resource developments. Rural domestic and livestock water requirements, farm income, and farm employment estimates are being developed from these projections. Further analysis is estimating the economic potential for drainage, irrigation, and flood protection in meeting the Basin demands for food and fiber. Tests will be made of the sensitivity of the model to change in prices and change in yields due to weather variability.

Study was initiated of evaluation procedures for estimating the economic benefits resulting from the reduction of frequency and magnitude of flooding on agricultural flood plains. An empirical test of alternative procedures will be conducted on the Wabash River Basin (Indiana and Illinois) to derive a procedure suitable for general application.

The usefulness of Computer Simulation for River Basin Analysis was the subject of a study conducted during the year. Incorporation of socioeconomic variables with biological and engineering factors in river basin planning requires the analysis of a complex system of feedbacks, nonlinearities and lag structures. Computer simulation appears to be well suited to perform such analysis. A generalized flow chart was developed to indicate the linkages among the variables and to identify critical elements of a proposed analysis. Migration rates and cause-effect relationships affecting farm size appear to be key elements in the construction of a model to determine the interaction between biological, engineering, economic and social factors and resource development plans for agricultural purposes in a river basin.

An analytical model was constructed to appraise agricultural production capability and the relative efficiency of alternative patterns of land use and water resources development in the Big Sioux River Basin (South Dakota). Input data for the model included basin projections of agricultural production requirements, inventory of land availability by soil and typical cropping pattern, current and projected crop yields by soil together with associated fertilizer use, crop production costs, and acreages of soils with potential for development. Projections of agricultural and nonagricultural population and employment for 1980, 2000, and 2020 were furnished to cooperating agencies.

The study of the Sabine River Basin (Texas) was completed and the results are in process of publication. Agriculture and forestry will continue as the major land uses, but urban expansion and water resource developments will reduce the agricultural land base. Opportunities for agricultural land development in the basin are limited. Project type developments for flood prevention, drainage and recreation are anticipated; irrigation, however, will be limited to nonproject development. Water supply and water quality will not be limiting factors in determining the future of agriculture in the basin.

Institutional obstacles to water resources development in the Lower Rio Grande River Basin (Texas) were inventoried and classified. Existing institutions have restricted development and will restrict future development unless adjustments are made. Analysis of land use in the basin is nearing completion. Marketing problems, infrequent water shortages, poor drainage, and saline water and soils have affected returns to crop enterprises. These conditions must be corrected for agricultural production and economic activity in the basin to reach their potential.

The Arkansas River Basin (Kansas) was divided into five planning units for analytical purposes. Agricultural base data were compiled and analyzed for the Cimarron Unit. In addition, trends in both agricultural and nonagricultural population, income and employment have been analyzed. A study of the economic effects of drought in this area is in process. Regression analyses were made of the relation between rainfall occurrence and the value of crop and livestock production. An input-output table for the area is being constructed and will be used to estimate the secondary effects of decreased agricultural production due to drought.

Progress on studies of the Big Blue, Little Blue, Niobrara and Nemaha River Basins (Nebraska) included preparation of reports on the Big Blue and Little Blue Rivers, and trend analyses made of the agricultural economy in the Niobrara and Nemaha Basins. These analyses describe changes over time in significant economic variables and compare changes in the basins to changes in the State as a whole.

The economic base study report for the Willamette River Basin (Oregon) is expected to be published in fiscal year 1968 as an appendix to the comprehensive river basin report. Impacts of urban land use changes on the agricultural land base and future demands for irrigation, drainage, and other agricultural resource developments were evaluated. Preliminary projections show a population increase in the basin from 1.3 million in 1965 to 3.6 million in 2020. Personal income is projected to increase 2.2 percent

annually during the next 50 years. About one in five employed persons in the basin would be engaged in forestry, agriculture, mining, and food processing. Agricultural output is projected to increase 2.5 times by 2020. Food processing is a major industry, second only to forestry in employment.

Major effort during the year on the study of the Puget Sound Basin (Washington) was devoted to an economic study for the comprehensive report and plan for the basin. Data on present and projected levels of economic activity, developed within an input-output framework, will serve as a major input for the analysis of all development needs for water and related land resources. An input-output model was developed for the basin with projections for 1980, 2000, and 2020. Total value of crop and livestock production is projected to increase from \$128 million in 1963 to \$165 million in 1980, and \$274 million in 2020. Milk, eggs, broilers, vegetables, and berries are the main sources of agricultural income. Farmland is projected to decrease more than 50 percent by 2020, and number of farms to decrease 65 percent by 2020.

In the Sevier River Basin (Utah), work was primarily concerned with analysis of farm survey data for programming purposes. An analysis was made of procedural problems relating to evaluation of increments of irrigation water for alfalfa production. This study pointed up critical data, needs, and important variables for an appraisal of this kind. Optimum moisture days and actual consumptive use of moisture were better measures of water use than gross amounts of irrigation water applied. The study showed an optimum use of water in the Sevier Valley for alfalfa of 40 inches per acre. A report of the study was prepared for publication and another report on the agricultural economy of the Sevier Basin was published during the year.

Separate studies and reports are being made for each subbasin of the Colorado Rivers, with the total program to include the entire State. The economic studies include a description of present economic activity and of the present resource base; an appraisal of selected resource adjustments; an evaluation of impact of special problems such as drought, poor drainage, and floods; evaluation of specified and needed changes in land use patterns and resource development needs in terms of projected demand; and appraisal of major problems in the attainment of desirable resource goals. Studies have been completed for four (Gunnison, Upper Main Stem, Yampa, and White) of the six subbasins in the portion of the Colorado River Basin in the State of Colorado. Studies have been initiated in the other two subbasins, Dolores and San Juan.

Since the Oregon Rivers Basin studies were initiated in 1960, seven reports have been completed. During fiscal year 1967 a study of the Malheur Lake Drainage Basin was completed and a preliminary report prepared for publication. Investigation is underway on two other basins--Malheur and Owyhee Rivers. The preliminary report on the Powder River Basin is in process of revision. These are reconnaissance surveys of individual Oregon drainage basins, with emphasis on water and related land resource problems and potentials. Study of the North Coast Drainage Basin continued. The basin contains about 1.7 million acres, of which 86 percent is forested. Agriculture is based on livestock and forage production. Dairy products account for 55 percent of the farm income. Only 12,000 acres are irrigated, although about 52,000 additional acres could be irrigated.

Work on the Central Lahontan Basin (Nevada) study during the year consisted mainly of designing analytical models for deriving irrigation water demand in the Walker River Subbasin. Five areas of agricultural production in the subbasin were delineated for analysis and portions of the subbasin report dealing with economic development were prepared. As part of the basin study, a three-year contract was signed with the University of Nevada to conduct a special study of recreation methodology and demand.

The Eel River Subbasin was selected as the first area of investigation in the North Coastal Basin (California). An inventory and review of available data were largely completed, a work outline was developed, and a description of the resource base is nearly completed. Review and adaptation of data from State studies has been a major task to date. Preliminary investigations have disclosed a major deterioration of resources in the Dry Creek area of this basin. The problem stems in part from institutional aspects, with absentee ownership and tenancy being a prevalent characteristic. Efforts are being made to arrange for a special study of this problem.

Data collection and analysis continued on the Upper Rio Grande Basin (New Mexico) study. A first draft report was prepared for the Chama-Otowi Subbasin. Work was initiated in the second of six subbasins to be studied.

Plans were completed for an intensive study of recreation potentials in the basin. The area is characterized by low incomes and unemployment, and agriculture is relatively unimportant. Opportunities appear to exist for recreational development that would provide employment and income to local people. Data for the study are being obtained from a mail survey of motels, hotels, and lodges, and from an enumerative survey of campground uses. The study, initiated after an urgent request from local people, is being carried out in connection with the Upper Rio Grande RC&D Project.

PUBLICATIONS--USDA AND COOPERATIVE PROGRAM

- Green, William A. 1967. Economic issues and problems in river basin planning. In Workshop on Water Research Needs. Univ. of Fla. IFAS Bul. No. 3. (In process).
- Hostetler, John E. 1967. Big Muddy River Basin comprehensive study, Illinois: appendix K, agriculture. Cooperative report by SCS, ERS, and FS. U.S. Dept. of Agriculture.
- Jones, Gary. 1967. An economist's views of water research needs in Florida. In Workshop on Water Research Needs. Univ. of Fla. IFAS Bul. No. 3. (In process).
- Natural Resource Economics Division, ERS. 1967. Pascagoula River Basin comprehensive study: appendix F, agricultural requirements and upstream watershed development. Cooperative report by SCS, ERS, and FS. U.S. Dept. of Agriculture.
- USDA. 1966. Report on water and related land resources, North Coast Drainage Basin, Oregon. 148 pp.
- Wilson, David L. 1966. Agricultural economy of the Sevier River Basin, Utah. Natural Resource Economics Division, ERS. Salt Lake City. Unnumbered report. 60 pp.

AREA NO. 11. NATURAL RESOURCE MANAGEMENT FOR COMMUNITY DEVELOPMENT

Problem. This area of work is concerned primarily with providing technical assistance and conducting studies of economic feasibility and impacts as a part of the Resource Conservation and Development Projects Program authorized under provisions of the Food and Agriculture Act of 1962. An RC&D project is a locally initiated and sponsored activity. The objective of the program is, "to expand the economic opportunities for the people of an area by developing and carrying out a plan of action for the orderly conservation, improvement, development and wise use of their natural resources."

USDA AND COOPERATIVE PROGRAM

The program of technical assistance and applied research is carried out in four major areas: (A) Assistance in formulating the economic aspects of the project plan; (B) economic studies of project proposals which would have effects beyond the project area; (C) program assistance at the national level; and (D) evaluation of economic impacts in selected project areas. Program activities are undertaken in Washington, D.C. and in five field locations with regional headquarters in Little Rock, Arkansas; Fort Collins, Colorado; East Lansing, Michigan; Upper Darby, Pennsylvania; and Logan, Utah. The program of support is guided by annual work plans prepared under a Memorandum of Agreement with the Soil Conservation Service effected in 1964. There are currently 41 projects authorized for planning or operations. Nearly all projects involve multicounty areas.

During the reporting period, work was carried out under formal cooperating arrangement with the Minnesota Agricultural Experiment Station and informally with several other experiment stations.

A total of 4.8 Federal scientist man-years was devoted to this effort during the reporting period.

PROGRAM OF STATE EXPERIMENT STATIONS

The State Experiment Stations have no research classified specifically in this area of work.

PROGRESS--USDA AND COOPERATIVE PROGRAMS

A. Technical Assistance in Formulating Project Work Plans

During the year, some form of assistance was provided to project sponsors in 29 States. This activity included the assembly of basic socioeconomic data and recent trends, consultation with the sponsoring groups, and assistance in making probable estimates of the impact on incomes and employment from installation of proposed project measures.

B. Economic Studies of Proposed Project Measures

A study of the feasibility of processing and marketing wood shavings and sawdust in the West was completed and published. This study indicated a very

promising potential in many areas where sufficient raw materials are available. However, the low capital requirement required for entry could lead to over-production in a short time.

Analyses and technical assistance are being provided on various recreation proposals throughout the country. Evaluation of recreation enterprises have been carried out in Georgia. Proposals for community development of recreation facilities around water impoundments are being studied in Vermont, Wisconsin, and Minnesota. A mail survey is being used to collect data for a recreation study in the New Mexico project area. In addition, a study is underway in Georgia to evaluate the effectiveness of the RC&D program for fostering orderly and economic development of resources within a metropolitan area.

C. Program Assistance at the National Level

Staff work was carried out in cooperation with SCS personnel. Resource Conservation and Development project work plans were reviewed and comments provided. Joint evaluations of economic impacts associated with the program were completed for RC&D projects located in Pennsylvania, Minnesota, Georgia, and Oregon. Data and relationships obtained from this effort are being used to design a consistent system for evaluating and reporting project impacts in terms of income, employment and nonmarket effects.

D. Evaluation of Economic Impacts

Work is continuing on the evaluation of economic impacts in selected project areas and on the development of methodology which is sufficiently accurate and flexible for measurements of impacts resulting from this very broad resources development program.

A study of water-oriented small tract properties in Price County, Wisconsin was completed. Estimates were made of the economic impact on the local economy in terms of increased revenues and incomes.

A study of the Crow Wing Canoe Trail in Minnesota has been made and results will be forthcoming shortly. Results from this study, which was made in cooperation with the Minnesota Agricultural Experiment Station, holds promise for other similar developments located in RC&D areas.

Several studies are underway which are providing a test of various approaches to measurement of economic impacts. In Pennsylvania, data has been collected for the analysis of the impact on a local economy of the installation of a summer home community around a small reservoir.

Line Project Check List--Reporting Year October 1, 1966 to September 30, 1967

Work and Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Project Incl. in	
			Summary of Progress (Yes-No)	Area and Subheading
<u>NRE 1</u>	<u>Land Utilization</u>			
NRE 1-1	National land use inventory	Washington, D.C.; Ithaca, N.Y.; and Dallas, Texas	Yes	1-A
NRE 1-2 (Rev.)	Economic appraisal of land resource development in the United States	Washington, D.C.; St. Paul, Minn.; Tucson, Ariz.; Honolulu, Hawaii; and New Brunswick, N.J.	Yes	1-B
<u>NRE 2</u>	<u>Water Use and Management*</u>			
NRE 2-1	Economic appraisal of agricultural water use and supply**	Washington, D.C.	No	
NRE 2-2	Improved method for the economic evaluation of land and water resource development projects and programs**	Washington, D.C.	No	
NRE 2-3	Economic appraisal of humid-area irrigation trends, potentials, and water values	Washington, D.C. & Madison, Wis.	No	
NRE 2-4	Economics of watershed management**	Washington, D.C.	No	
NRE 2-5	Value of water for irrigation in the Willamette Valley**	Corvallis, Oreg.	No	
RDE 2-6	Economic appraisal of irrigation conveyance systems in California **	Washington, D.C.	No	
<u>NRE 3</u>	<u>Legal-Economic Aspects of Land and Water Use</u>			
NRE 3-1	Legal aspects of water rights in the West	Berkeley, Calif.	Yes	3-A
NRE 3-2	Legal aspects of water rights in the East	Washington, D.C.; Madison, Wis.; & Oxford, Miss.	Yes	3-A
NRE 3-3	Analysis of rural zoning enabling statutes and ordinances	Washington, D.C.	Yes	3-B
NRE 3-4	Economic appraisal of local resource organizations	Washington, D.C. & St. Paul, Minn.	Yes	3-C
NRE 3-5	Analysis of the feasibility of easements and protective covenants for guiding rural land use		No	

*Projects to be terminated and replaced by Research Work Units, now in process of approval.

**Terminated during reporting year.

Line Project Check List--Reporting Year October 1, 1966 to September 30, 1967

Work and Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Project Incl. in	
			Summary of Progress (Yes-No)	Area and Subheading
<u>NRE 4</u>	<u>Land Tenure</u>			
NRE 4-1	Development and analysis of basic farm tenure information	Washington, D.C. & East Lansing, Mich.	Yes	4-A
NRE 4-2	Appraisal of economic aspects of land tenure laws	Iowa City, Iowa	Yes	4-C
NRE 4-3 (Rev.)	Maintenance of information on farm leases	Washington, D.C.	No	
NRE 4-5	Public-private arrangements for the control and use of resources in the Western States	Ft. Collins, Colo.	Yes	4-B
<u>NRE 5</u>	<u>Impact of Urban Growth on Rural Areas</u>			
NRE 5-1 (Rev.)	Economic appraisal of impacts of urban growth on rural land use	Washington, D.C.	Yes	1-B
NRE 5-2	The economics of outdoor recreation as a use of rural land	Washington, D.C.; Atlanta, Ga.; Madison, Wis.; Ann Arbor, Mich.; & Columbia, Mo.	Yes	5
<u>NRE 6</u>	<u>Resource Income Distribution</u>			
NRE 6-1	Analysis of the Great Plains Conservation Program	Washington, D.C. & Ft. Collins, Colo.	Yes	6-B
NRE 6-2	Analyses of trends in land and other resource income	Washington, D.C. & Ames, Iowa	Yes	6-A
NRE 6-3	Incidences of benefits and costs of land use controls and tenure institutions in the North Central Piedmont	Washington, D.C.	No	
NRE 6-4	Effects of tenure institutions and government programs upon resource income distribution in the Central Great Plains	Ft. Collins, Colo.	Yes	6-B
NRE 6-5	Analysis of income distributional effects of alternative public programs in Southwestern States	Baton Rouge, La.	Yes	6-B
NRE 6-6	Identifying and measuring effects of technical, institutional, and economic forces upon farm resource income distribution	Washington, D.C. & St. Paul, Minn.	Yes	6-A
<u>(NRE 8)</u>	<u>Quality of Natural Resources</u>	Washington, D.C.	Yes	8